Data-Collection Technology

Vernier International

Chemistry | Physics | Biology | Biotechnology | Engineering | Physical Science
Math | Environmental | Water Quality | Earth Science | Physiology | Middle School

Vernier

CATALOGUE
2011

OREGON BUSINESS AWARD

2010 HEALTHIEST EMPLOYERS
4TH PLACE

BUSINESS JOURNAL CORPORATE
PHILANTHROPY AWARD

PLACED 10TH OF 100
BEST GREEN COMPANIES
IN OREGON

VERNIER IS A CORPORATE
MEMBER SUPPORTING STEM
EDUCATION IN THE U.S.

VERNIER IS PROUD TO BE RECOGNIZED FOR ITS PHILANTHROPIC COMMITMENT, ENVIRONMENTAL POLICY, STEADY GROWTH, AND AS ONE OF THE BEST 100 COMPANIES TO WORK FOR IN OREGON FOR 11 YEARS IN A ROW.

30 years!

This year we are celebrating our 30th Anniversary! Thirty years is a long time for a software/computer company. We started writing software and developing hardware for Apple II computers with up to 64K memory, running at 1 MHz. This year we are supporting computers several thousand times faster with a million times more memory. We thank our many loyal customers for allowing us to have 30 great years.

We are doing several things to celebrate this anniversary. We will be profiling "The Vernier Generation," young scientists and engineers who used Vernier technology during their science education and who have gone on to choose careers in Science, Technology, Engineering, and Math (STEM). Watch our e-newsletters for more 30th anniversary celebration surprises throughout the year.

In the last year, there has been a lot of attention given to STEM education. Supporting science, technology, engineering, and math has really been the cornerstone of our business since 1981, and we have joined organizations such as Change the Equation and the Triangle Coalition, which promote STEM education. We have also given back to the education community through participation in National Lab Day and our Vernier/NSTA Technology Awards. We hope some of this helps the effort to improve STEM education in the United States.

We continue to do our best to keep our prices as low as possible. We feel this is an important time to keep prices low in light of the many funding problems facing schools around the world.

As in every one of our 30 years, we have a lot of exciting new products. Check out our new equipment and sensors for chemistry, physics, and biology. We also have several new books, including an advanced physics book, an engineering projects book, and a book for agricultural science. We also recently introduced Video Physics, our first iOS application for the iPad, iPod touch, and iPhone.

As always, if you have questions or concerns, contact either of us directly.

Dave and Christine Vernier
dvernier@vernier.com and cvernier@vernier.com

VERNIER SOFTWARE & TECHNOLOGY

Vernier Software & Technology was co-founded in 1981 by Dave and Christine Vernier. Dave's background as a physics teacher and Christine's knack for business combined to form a company with a deep commitment to education.

Thirty years later, the company is still owned by Christine and Dave, along with eight employee owners who have backgrounds in science and math education, as well as business.

Experiment 10A Impulse and Momentum from the* Advanced Physics with Vernier – Mechanics *lab book.

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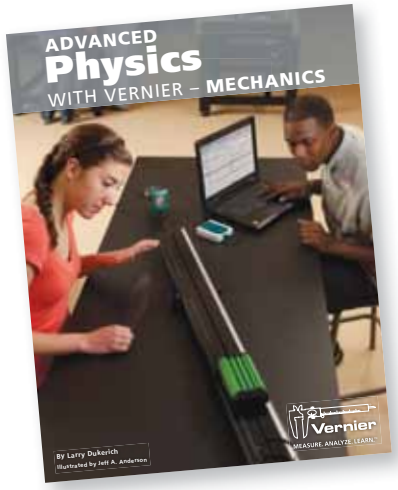
WHAT'S NEW



NEW *Advanced Physics with Vernier – Mechanics* lab book

This is the first of a two-volume set of experiments for the more in-depth introductory physics course, such as college physics, AP Physics, or IB Physics. Experiments are designed for an interactive teaching style with planned moments for instructor-led discussion.

*Page **70***

NEW Anemometer

The Vernier Anemometer is an impeller-type anemometer that measures wind speed in the range of 0.5 to 30 m/s (1 to 67 mph). The Anemometer fits in your palm for wind study measurements in the field. A standard camera mount on the back and an accessory rod allows you to position it in wind tunnels or in front of fans for wind turbine experiments.

*Page **102***

NEW High Current Sensor

Do you do experiments with solar panels or other high-current devices? The new Vernier High Current Sensor has a range of ±10 A. Current is measured with a Hall effect sensor, which uses the magnetic field created by the current.

*Page **105***

NEW 30-Volt Voltage Probe

Perfect for working with large solar panels, this new sensor is used to measure voltages in the range of ±30 V.

*Page **120***

NEW Centripetal Force Apparatus

The Centripetal Force Apparatus allows you to investigate the relationship between centripetal force, angular velocity, mass, and radius. Use in conjunction with a force sensor, photogate, or the Wireless Dynamic Sensor System.

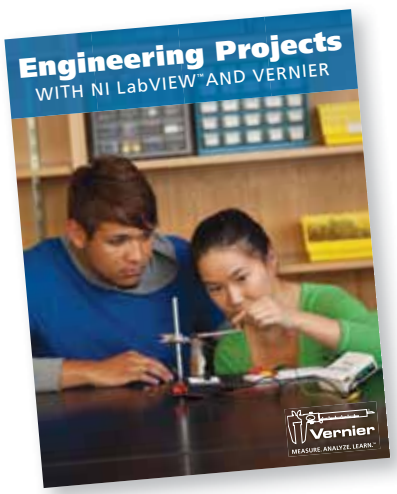
*Page **71***

NEW Melt Station

Teach organic chemistry? Our new Melt Station Melting Temperature Sensor connects to LabQuest or any Vernier computer interface to measure the melting temperature of solid substances.

- Accurate results using built-in RTD over a range of 20°C to 260°C
- High-quality 6X viewing lens for clear observation of the samples

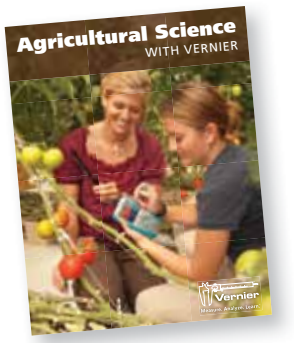
*Page **37***



NEW *Engineering Projects with NI LabVIEW™ and Vernier* lab book

Looking for hands-on engineering projects? This engaging new lab book contains activities for SensorDAQ, LabQuest, or LabQuest Mini. Introduce your students to engineering concepts and programming with NI LabVIEW and Vernier sensors.

*Page **54***



NEW *Agricultural Science with Vernier* lab book

This new lab book contains experiments for teaching topics in agricultural science at the high school or college level. Experiments range from the investigation of factors affecting transpiration to the temperature effect shearing has on sheep.

*Page **89***

NEW TI Nspire Data-Collection System

Introducing the new Vernier DataQuest™ Application and the new TI-Nspire Lab Cradle multi-channel interface. Use it with more than 50 Vernier sensors for a full-featured, data-collection solution for TI-Nspire technology.

*Page **97–98***

NEW 2.2 m Track

Looking for an extra-long track for demonstrations or complex collisions? Vernier's new 2.2 m Track is compatible with all accessories for the Vernier Dynamics System, including the Optics Expansion Kit, and Color Mixer Kit.

*Page **76***

INTERFACES—COMPATIBILITY / PRICE CHART

CHOICES	SUPPORTED PLATFORMS	MAXIMUM SAMPLING RATE	COMPATIBLE VERNIER SENSORS	REMOTE DATA COLLECTION	BUILT-IN COLOR SCREEN	RECHARGEABLE BATTERY	BUILT-IN SENSORS	SUPPORTS MULTIPLE SENSORS	SOFTWARE	STANDARDS-BASED LABS
ⓐ **LabQuest®** SEE PP. 5–11 ORDER CODE **LABQ**	Computers or Standalone	100,000 per second	71	Built in	Yes	Yes	Temperature Microphone	Yes	Built-in LabQuest Application See pp. 10–11 Logger Lite (included) Logger *Pro* (not included) See pp. 16–19	100 Built-in labs 300+ more available on web site 400+ labs available in print See page 9
ⓑ **LabQuest® Mini** SEE PP. 12–13 ORDER CODE **LQ-MINI**	Computers	100,000 per second	58	With a laptop computer	No	No batteries needed (USB powered)	None	Yes	Logger Lite (included) Logger *Pro* (not included) See pp. 16–19	300+ more available on web site 400+ labs available in print
ⓒ **Go!® Link** SEE PAGE 14 ORDER CODE **GO-LINK**	Computers	200 per second	50 sensors See page 101 for a compatible sensor list	With a laptop computer	No	No batteries needed (USB powered)	None	No	Logger Lite (included) Logger *Pro* (not included) See pp. 16–19	300+ more available on web site 400+ labs available in print

FOR TI CALCULATOR-BASED DATA COLLECTION: see pp. 94–100

VERNIER LABQUEST®

The freedom to inquire. The technology to excel.

ORDER CODE
LABQ

Breakthrough data-collection technology—the Vernier LabQuest®

Presenting the most powerful and intuitive interface for science education. Engage your students with hands-on science in your classroom or in the field.

Use it as a standalone device or as a computer interface with our award-winning Logger *Pro* software. Created with today's classroom in mind, you will love its durability, vivid color touch screen, and ease of use. And, of course, since it was developed by Vernier, it is backed by comprehensive curriculum, a generous warranty, and legendary support.

Collect buttons

Navigation keys
Provides quick access to key features

Built tough. Built to last.
Designed with students in mind, the rubber overmolding and rugged mechanical design provide protection against everyday bumps, falls, and splashes

Stylus

Built-in microphone
Record voice annotations or collect sound data

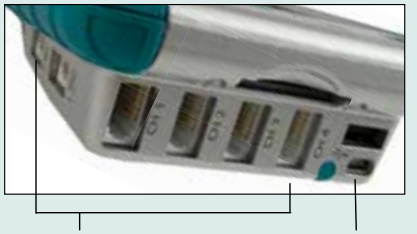
- 320 x 240 color graphic display
- LED backlighting provides you with outstanding clarity in the classroom or in the field

Built-in temperature sensor

Fast sampling rate
100,000 samples per second

Rechargeable batteries
High quality, lithium-ion rechargeable battery pack usually lets you go a school day before recharging. [Note: some sensors and types of experiments require more charge than others, so a brief mid-day charge may be necessary.]

Included with LabQuest: LabQuest unit; power adapter; USB cable; CD containing Logger Lite software, LabQuest reference guide, LabQuest Emulator Software; Quick-Start Guide; 2 Styluses; Stylus tether



Six sensor ports
- Provides maximum versatility
- Compatible with your existing Vernier sensors

Computer interface
Connect LabQuest to a Windows or Macintosh computer via USB to collect data in Logger *Pro*.

Stylus

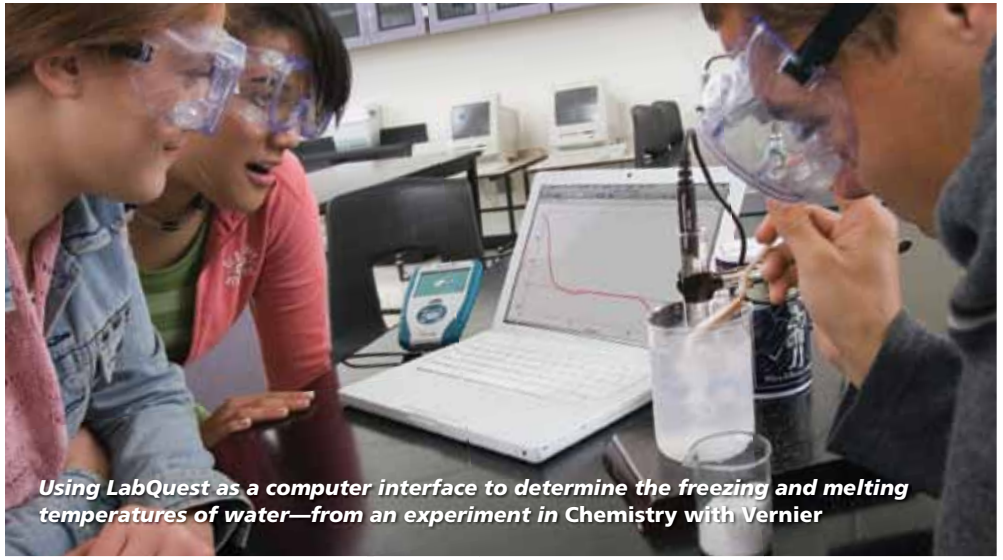
Audio in

Power
Connect to power and recharge LabQuest's built-in battery

Audio out
Use audio out to connect headphones or speakers

SD/MMC card slot

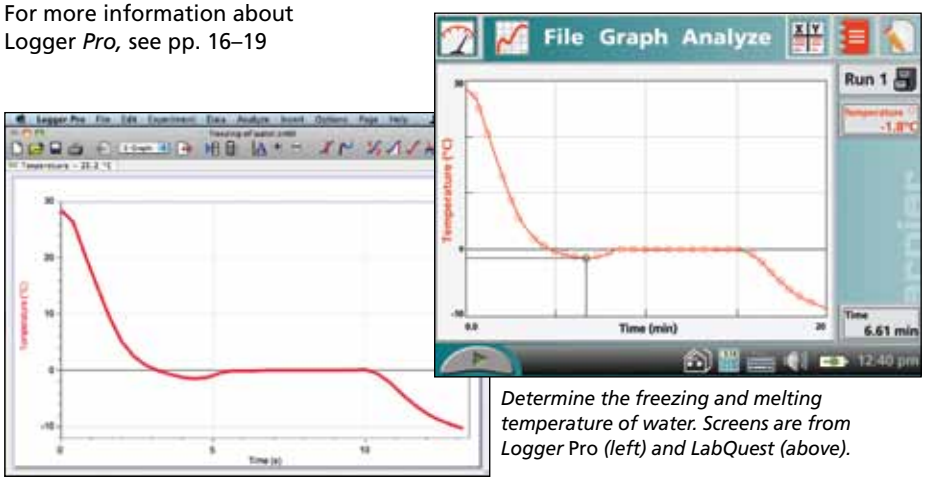
USB Peripherals expansion
Connect to a printer, Flash drive, or other devices using USB



***Using LabQuest as a computer interface to determine the freezing and melting temperatures of water—from an experiment in* Chemistry with Vernier**

Easily download your data from LabQuest to a computer for further analysis with Logger *Pro* Software.

For more information about Logger *Pro,* see pp. 16–19



Determine the freezing and melting temperature of water. Screens are from Logger Pro *(left) and LabQuest (above).*

LABQUEST COMPATIBLE SENSORS

SENSOR	CODE
Accelerometers	
3-Axis Accelerometer	3D-BTA
25-gA ccelerometer	ACC-BTA
Low-g Accelerometer	LGA-BTA
NEW Anemometer	ANM-BTA
Barometer	BAR-BTA
Blood Pressure Sensor	BPS-BTA
Charge Sensor	CRG-BTA
CO_2 Gas Sensor	CO2-BTA
Colorimeter	COL-BTA
Conductivity Probe	CON-BTA
CurrentPr obes	
CurrentPr obe	DCP-BTA
NEW High Current Sensor	HCS-BTA
Digital Control Unit	DCU-BTD
Dissolved Oxygen Probe	DO-BTA
DropCount er	VDC-BTD
Dual-Range Force Sensor	DFS-BTA
EKG Sensor	EKG-BTA
ElectrodeA mplifier	EA-BTA
Flow Rate Sensor	FLO-BTA
ForcePlat e	FP-BTA
Gas Pressure Sensor	GPS-BTA
Vernier GPS Sensor	VGPS
Hand Dynamometer	HD-BTA

SENSOR	CODE
Hand-Grip Heart Rate Monitor	HGH-BTA
Instrumentation Amplifier	INA-BTA
Ion-Selective Electrodes	
Ammonium Ion-Selective Electrode	NH4-BTA
Calcium Ion-Selective Electrode	CA-BTA
Chloride Ion-Selective Electrode	CL-BTA
Nitrate Ion-Selective Electrode	NO3-BTA
Light Sensor	LS-BTA
Magnetic Field Sensor	MG-BTA
NEW Melt Station	MLT-BTA
Microphone	MCA-BTA
Mini Gas Chromatograph	GC-MINI
Motion Detector	MD-BTD
O_2 Gas Sensor	O2-BTA
ORP Sensor	ORP-BTA
pH Sensor	PH-BTA
pH Sensor, Tris-Compatible Flat	FPH-BTA
Photogate	VPG-BTD
Power Amplifier	PAMP
Radiation Monitor *(Digital)*	DRM-BTD
Relative Humidity Sensor	RH-BTA
Respiration Monitor Belt *(requires GPS-BTA)*	RMB
Rotary Motion Sensor	RMV-BTD
Salinity Sensor	SAL-BTA
Soil Moisture Sensor	SMS-BTA

SENSOR	CODE
Sound Level Meter	SLM-BTA
Spectrometers	
SpectroVis Plus	SVIS-PL
Ocean Optics Spectrometers	
Vernier Spectrometer	V-SPEC
Red Tide Spectrometer	SPRT-VIS
Red Tide UV-VIS Spectrometer	SPRT-UV-VIS
Red Tide Emissions Spectrometer	ESRT-VIS
Spirometer	SPR-BTA
Temperature Probes	
Extra-Long Temperature Probe	TPL-BTA
Infrared Thermometer	IRT-BTA
Stainless Steel Temperature Probe	TMP-BTA
Surface Temperature Sensor	STS-BTA
Thermocouple	TCA-BTA
Wide-Range Temperature Probe	WRT-BTA
Turbidity Sensor	TRB-BTA
UVA Sensor	UVA-BTA
UVB Sensor	UVB-BTA
Voltage Probes	
Differential Voltage Probe	DVP-BTA
Voltage Probe	VP-BTA
NEW 30-Volt Voltage Probe	30V-BTA
Watts Up Pro	WU-PRO
Wireless Dynamics Sensor System*	WDSS

Go! Temp, Go!Motion, Garmin eTrex Venture HC are compatible with LabQuest App 1.2 or newer. The Digital Control Unit is compatible with Logger *Pro* 3.7 or newer.
*Requires BLUE-USB, see page 121.

For more information about sensors, see pp. 101–122

TECHNICAL SPECIFICATIONS

SCREEN SIZE	7 cm x 5.3 cm
SCREEN RESOLUTION	320 x 240 color graphic display
WEIGHT	350 g
INPUT METHOD	Touch screen, on-screen keyboard, attach an external keyboard, or buttons
CPU	416 MHz Application Processor
SAMPLING RATE	100,000 samples per second
STORAGE	40 MB built-in, SD/MMC card slot for expandability
BATTERY	Lithium-ion rechargeable
DURABILITY	Water resistant and will withstand a fall from a classroom lab bench

actual size

ORDER CODE
LABQ

Key Features:

- Sample data at 100,000 samples per second
- Download over 400 teacher-tested experiments FREE using the Lab Organizer
- Get started quickly with free Logger Lite software
- Choose from 71 compatible sensors
- Buy with confidence knowing LabQuest is backed by a 5-year warranty

MultiMedia & Internet@Schools

a. WiFi USB Adapter, ORDER CODE **WIFI-USB**
Add wireless connectivity to your LabQuest with the Vernier WiFi USB Adapter. For details, see www.vernier.com/labqwifi

---

b. LabQuest Lanyard, ORDER CODE **LQ-LAN**
This lanyard connects to the back of your LabQuest and gives students even more freedom to explore. Best of all, you don't have to worry about students dropping their interface during field studies.

---

c. LabQuest Charging Station
ORDER CODE **LQ-CRG**

Multi-bay charging capability for your LabQuest

Want a way to charge and store your LabQuests? The LabQuest Charging Station is the perfect solution. Each charging station has four charging slots. LEDs on the charging station indicate the charging status. The compact design uses desk space efficiently. Because the charger holds four LabQuests, it is easy and affordable to accommodate small and large lab setups.

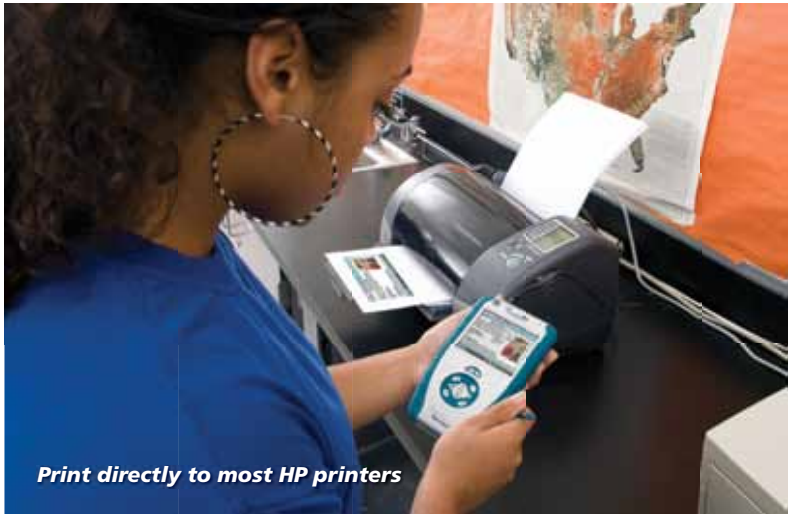
---

d. NEW LabQuest Battery Boost
ORDER CODE **LQ-BOOST**
The Battery Boost is a rechargeable external battery for your LabQuest. With the added power of an external battery, data can be collected for extended periods in the field where AC power is not available.

Print Directly from LabQuest

LabQuest can print directly to most HP printers. Simply connect LabQuest to the printer with a standard USB cable and choose Print from the File menu. Choose full-color or grayscale, and you'll get a full-size print in moments. For details, see www.vernier.com/labqprinters

Built tough! Environmental Specifications: 0–70° C, splash and moisture resistant, rugged enclosure with rubber molding for shock absorption


Print directly to most HP printers

My LabQuest Library

Vernier has embedded over 100 of our most popular science experiments into LabQuest. My LabQuest Library allows you to create, customize, organize, and download labs to LabQuest for the entire class.

www.vernier.com/mylabquest

LAB CREATOR

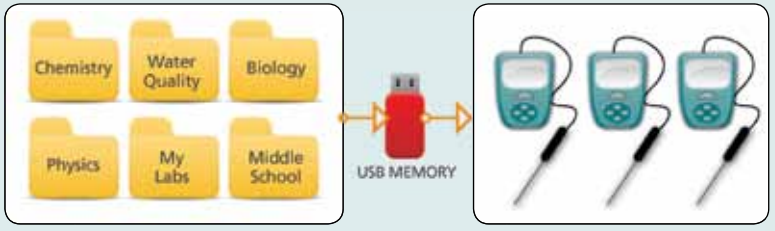
Create your own labs with the Lab Creator

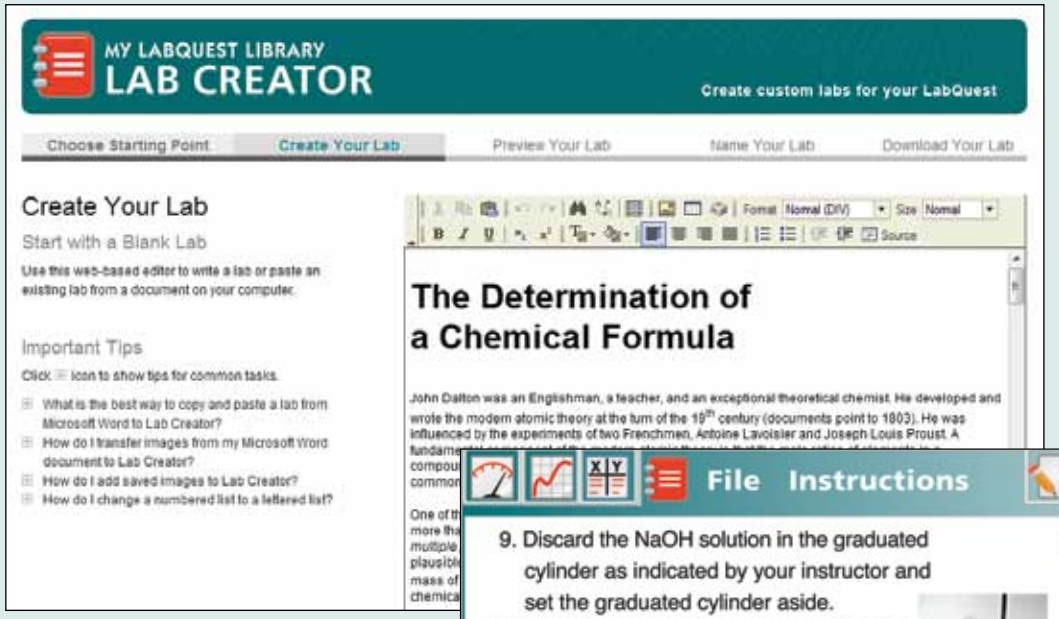
This **FREE** custom application allows you to create and easily upload your labs to LabQuest.

LAB ORGANIZER

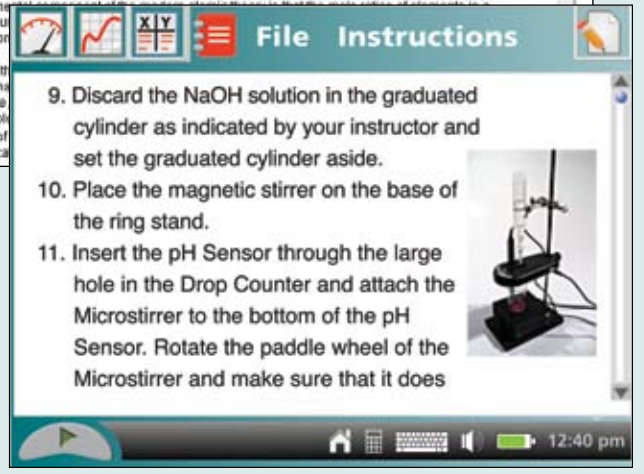
Customize your LabQuest with the Lab Organizer

In addition to our 100 most popular labs that are preloaded, more than 400 Vernier experiments from 16 lab books are available for you to upload to your LabQuest units!




MY LABQUEST LIBRARY
LAB CREATOR
Create custom labs for your LabQuest
Choose Starting Point
Create Your Lab
Preview Your Lab
Name Your Lab
Download Your Lab
Create Your Lab
Start with a Blank Lab
Use this web-based editor to write a lab or paste an existing lab from a document on your computer.
Important Tips
Click icon to show tips for common tasks.
What is the best way to copy and paste a lab from Microsoft Word to Lab Creator?
How do I transfer images from my Microsoft Word document to Lab Creator?
How do I add saved images to Lab Creator?
How do I change a numbered list to a lettered list?
The Determination of a Chemical Formula
John Dalton was an Englishman, a teacher, and an exceptional theoretical chemist. He developed and wrote the modern atomic theory at the turn of the 19th century (documents point to 1803). He was influenced by the experiments of two Frenchmen, Antoine Lavoisier and Joseph Louis Proust. A

Create your custom lab with the Lab Creator


File
Instructions
9. Discard the NaOH solution in the graduated cylinder as indicated by your instructor and set the graduated cylinder aside.
10. Place the magnetic stirrer on the base of the ring stand.
11. Insert the pH Sensor through the large hole in the Drop Counter and attach the Microstirrer to the bottom of the pH Sensor. Rotate the paddle wheel of the Microstirrer and make sure that it does
12:40 pm

Download it to your LabQuest

Project your lab to the classroom

FREE LabQuest Emulator Software

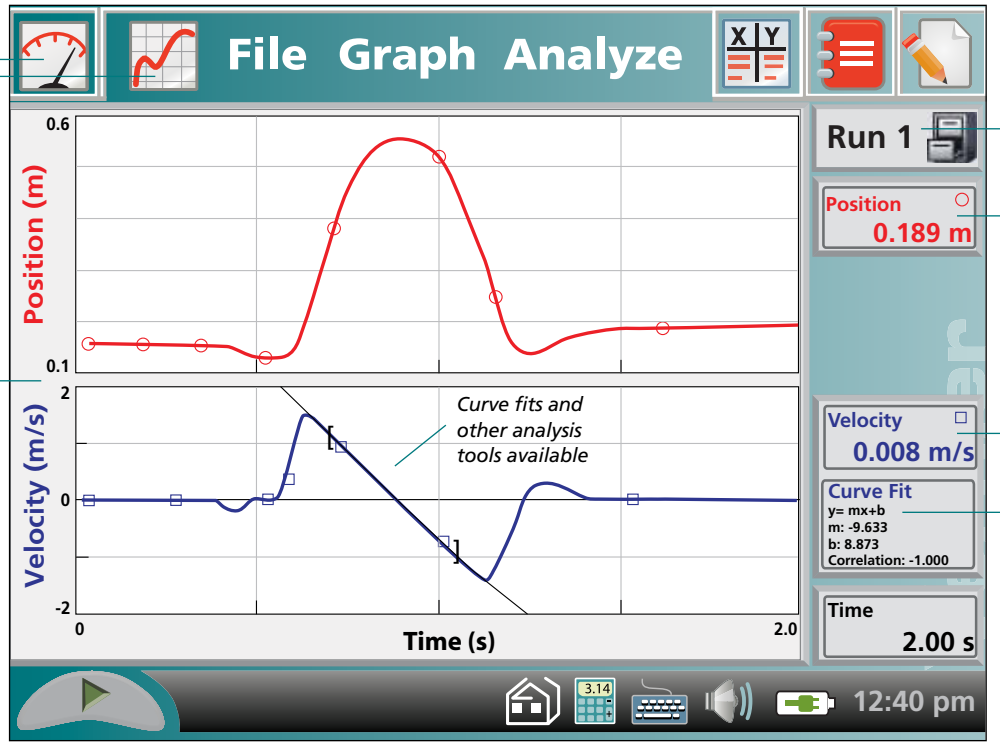
Looking for a way to project your LabQuest for an entire class to see? Connect your LabQuest to a computer running LabQuest Emulator software and project onto a screen or interactive whiteboard. *Runs on Windows XP, Vista, and Windows 7.*

Included with purchase of LabQuest or as a free download from www.vernier.com/labquest/emulator

LabQuest training videos

Watch as our teacher trainers guide you through several Vernier labs. These seasoned experts offer their favorite tips for collecting great data.

Go to **www.vernier.com/videos**



Quick access to graphs, tables, and meters

One or two high resolution plots of data are displayed in real time.

Curve fits and other analysis tools available

Multiple runs can easily be stored and recalled later.

Live display of sensor data

Curve fit statistics are displayed.

Built-In Software

ANALYSIS FEATURES

- Perform linear and curve fits
- Draw a prediction before collecting data
- Display two graphs at once
- Display a tangent line on the graph
- Autoscale
- Integral function
- Statistics

BUILT-IN APPLICATIONS

- Stopwatch
- Periodic table
- On-screen keyboard
- Scientific calculator
- Audio Function Generator
- Power Amplifier (requires Vernier Power Amplifier)

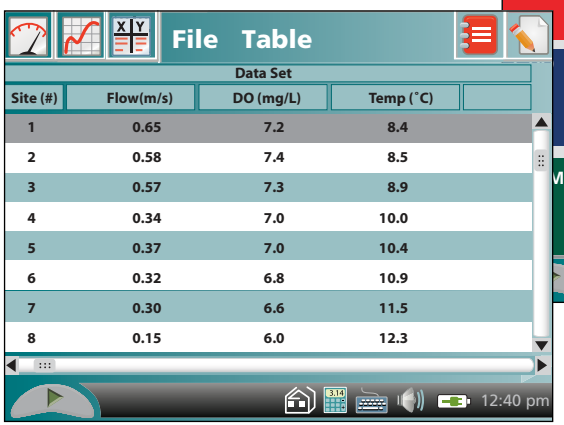
OTHER GREAT FEATURES

- Export data to Logger *Pro*
- More than 100 preloaded lab instructions from Vernier's popular lab books
- Notes field
- Voice annotation with internal microphone
- Find slopes, fit a line to a portion of your data, and display position data and its derivatives

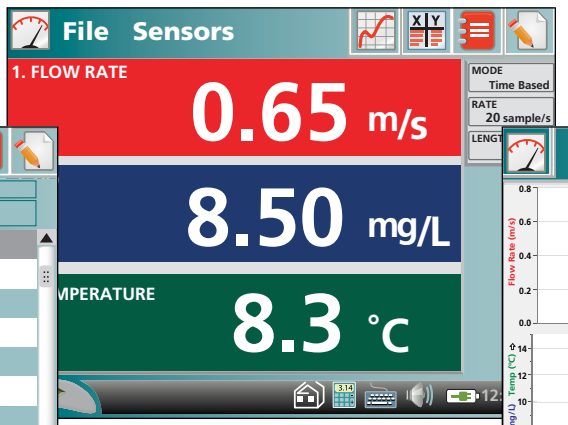
One-Touch Simplicity

The LabQuest Graphing and Analysis Application gives your students real-time graphing capabilities in a handheld device. It's powerful—yet beautifully simple.

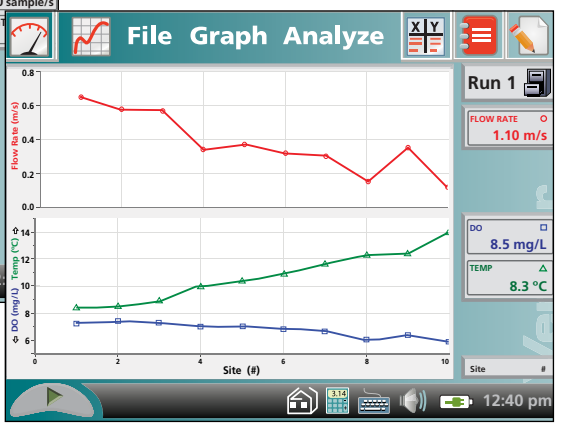
Your students can collect data and view them in a **Data Table, Meter,** and **Graph View.**



Data table

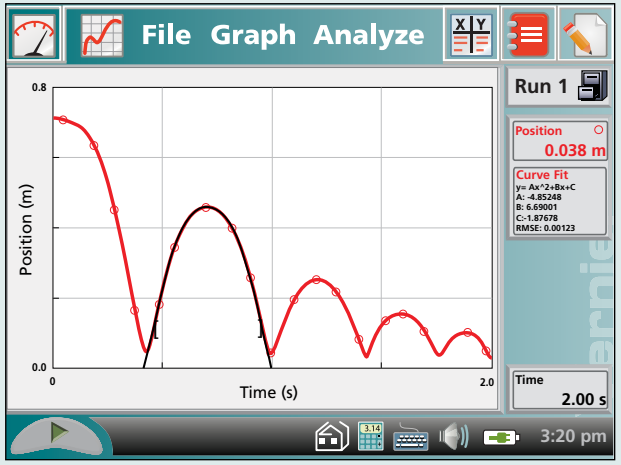


Meter

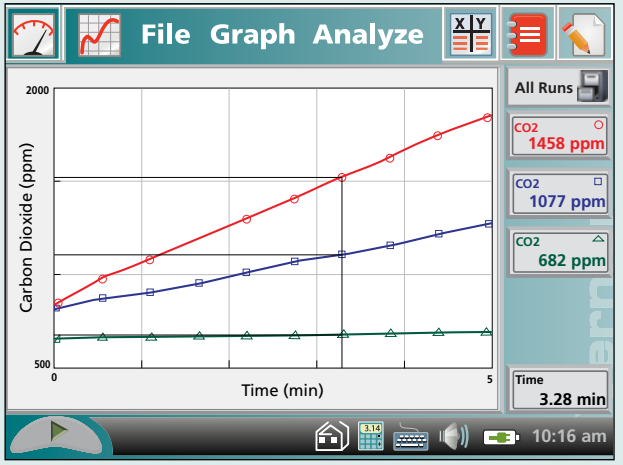


Graph

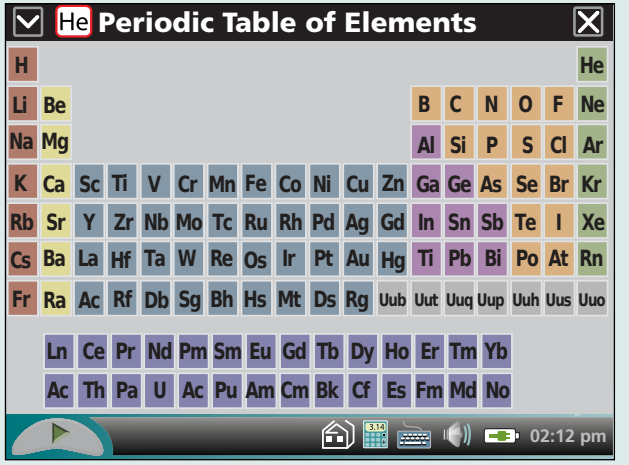
Data analysis and other applications at your fingertips



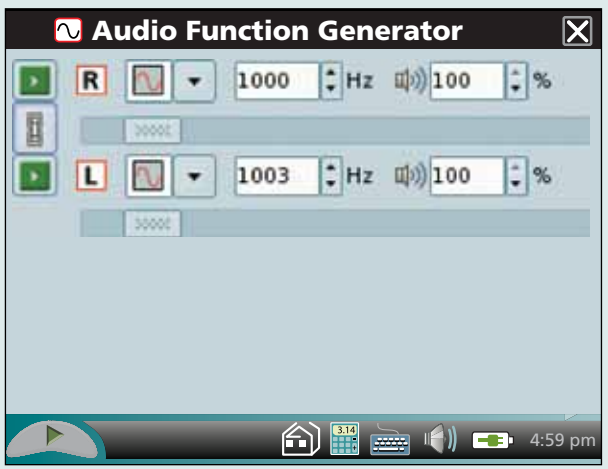
Collect position data. Show students how the ball bounces and fit a curve to your data.



Collect and display data for several sensors or runs on one graph.

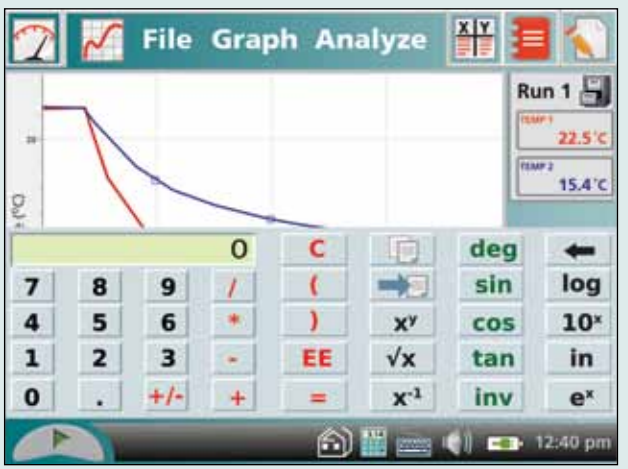

He Periodic Table of Elements
H
He
Li Be
B C N O F Ne
Na Mg
Al Si P S Cl Ar
K Ca Sc Ti V Cr Mn Fe Co Ni Cu Zn Ga Ge As Se Br Kr
Rb Sr Y Zr Nb Mo Tc Ru Rh Pd Ag Gd In Sn Sb Te I Xe
Cs Ba La Hf Ta W Re Os Ir Pt Au Hg Ti Pb Bi Po At Rn
Fr Ra Ac Rf Db Sg Bh Hs Mt Ds Rg Uub Uut Uuq Uup Uuh Uus Uuo
Ln Ce Pr Nd Pm Sm Eu Gd Tb Dy Ho Er Tm Yb
Ac Th Pa U Ac Pu Am Cm Bk Cf Es Fm Md No
02:12 pm

On-board Periodic Table



Audio function generator

Use LabQuest as a stopwatch



On-board scientific calculator

Do you do field work with your LabQuest?

LabQuest's new Data Matrix mode lets you collect and graph data over both time and location. It also lets you change sensors during data collection, allowing you to use as many different sensors as needed, all in one file.

Screen shots shown at 300 dpi print quality. Actual screen resolution on the LabQuest is 320 x 240 color graphic display.

VERNIER LABQUEST® MINI

ORDER CODE
LQ-MINI

Powerful. Affordable. Easy to Use.

LabQuest Mini brings the power of Vernier's award-winning LabQuest technology to teachers who don't need the versatility of a standalone device. The perfect solution for educators collecting data with a computer, LabQuest Mini interfaces with Logger *Pro* software for unparalleled power, analysis, and curricular support.

Key features include:

- 100 kHz maximum sampling rate gives you the unrivaled power of LabQuest
- Five sensor ports give you the flexibility to choose from 58 compatible sensors.
- Logger Lite software gets your students collecting, graphing, and analyzing data. And the best part? It is free with purchase.

"Excellent product that will serve many classroom environments well."
– Tech & Learning

Five Total Sensor Ports

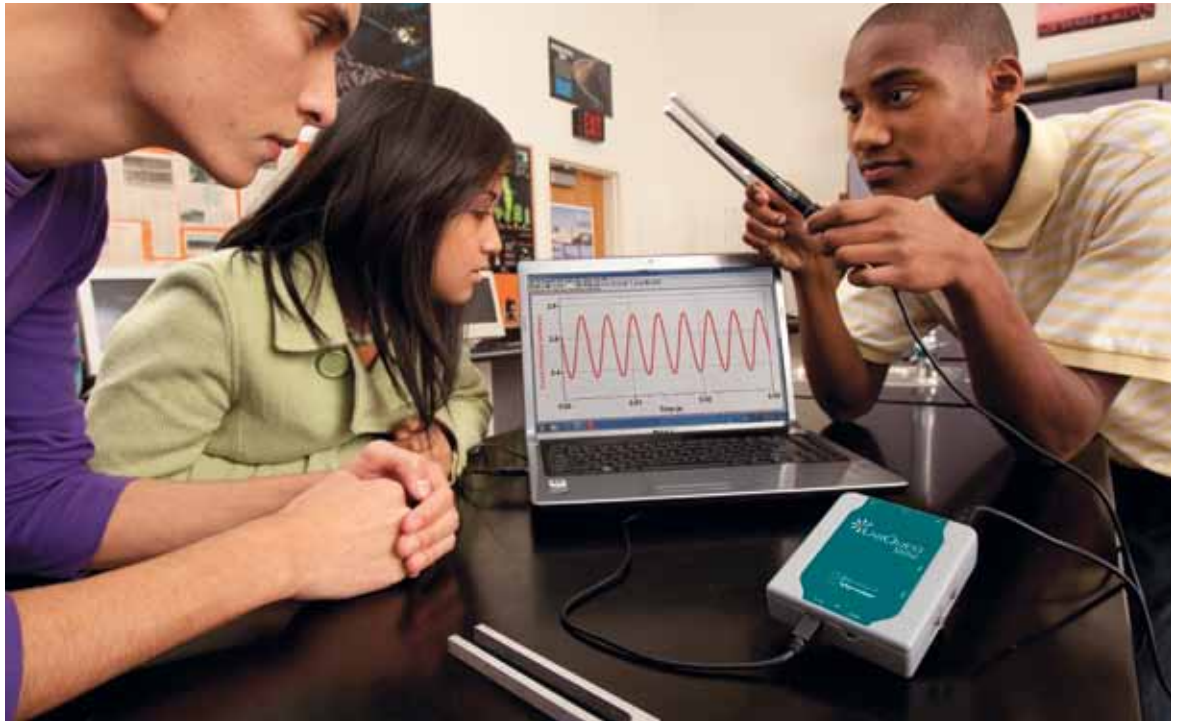
Three Sensor Ports
For use with 52 compatible sensors such as temperature, pH, and Gas Pressure Sensors.

Two Digital Sensor Ports
For use with motion detectors, photogates, radiation monitors, rotary motion sensors, and drop counters.

Collecting data exclusively on computers or netbooks?

LabQuest Mini may be perfect for you!

- Comes with FREE Logger Lite software to get your students quickly collecting and analyzing data.
- Looking for more advanced features than Logger Lite provides? Our award-winning Logger *Pro* 3 software provides advanced analytical features including video analysis. See pp. 16–19 for additional details.
- Use with over 20 Vernier lab books covering core topics in Biology, Chemistry, Earth Science, Engineering, Environmental Science, Physical Science, Physics, Physiology, and Water Quality.



TECHNICAL SPECIFICATIONS

COMPUTER CONNECTION	USB 2.0 Full Speed
SOFTWARE REQUIREMENTS	Logger *Pro* 3.8.2 or newer
ANALOG INPUTS	3
DIGITAL INPUTS	2
SAMPLING RATE	100,000 samples per second

LABQUEST MINI COMPATIBLE SENSORS

SENSOR	CODE	SENSOR	CODE	SENSOR	CODE
Accelerometers		Force Plate	FP-BTA	Relative Humidity Sensor	RH-BTA
3-Axis Accelerometer	3D-BTA	Gas Pressure Sensor	GPS-BTA	Respiration Monitor Belt (requires GPS-BTA)	RMB
25-g Accelerometer	ACC-BTA	Hand Dynamometer	HD-BTA	Rotary Motion Sensor	RMV-BTD
Low-g Accelerometer	LGA-BTA	Hand-Grip Heart Rate Monitor	HGH-BTA	Salinity Sensor	SAL-BTA
NEW Anemometer	ANM-BTA	Instrumentation Amplifier	INA-BTA	Soil Moisture Sensor	SMS-BTA
Barometer	BAR-BTA	Ion-Selective Electrodes		Sound Level Meter	SLM-BTA
Blood Pressure Sensor	BPS-BTA	Ammonium Ion-Selective Electrode	NH4-BTA	Spirometer	SPR-BTA
Charge Sensor	CRG-BTA	Calcium Ion-Selective Electrode	CA-BTA	Temperature Probes	
CO_2 Gas Sensor	CO2-BTA	Chloride Ion-Selective Electrode	CL-BTA	Extra-Long Temperature Probe	TPL-BTA
Colorimeter	COL-BTA	Nitrate Ion-Selective Electrode	NO3-BTA	Infrared Thermometer	IRT-BTA
Conductivity Probe	CON-BTA	Light Sensor	LS-BTA	Stainless Steel Temperature Probe	TMP-BTA
Current Probes		Magnetic Field Sensor	MG-BTA	Surface Temperature Sensor	STS-BTA
Current Probe	DCP-BTA	NEW Melt Station	MLT-BTA	Thermocouple	TCA-BTA
NEW High Current Sensor	HCS-BTA	Microphone	MCA-BTA	Wide-Range Temperature Probe	WRT-BTA
Digital Control Unit	DCU-BTD	Motion Detector	MD-BTD	Turbidity Sensor	TRB-BTA
Dissolved Oxygen Probe	DO-BTA	O_2 Gas Sensor	O2-BTA	UVA Sensor	UVA-BTA
DropCount er	VDC-BTD	ORP Sensor	ORP-BTA	UVB Sensor	UVB-BTA
Dual-Range Force Sensor	DFS-BTA	pH Sensor	PH-BTA	Voltage Probes	
EKG Sensor	EKG-BTA	pH Sensor, Tris-Compatible Flat	FPH-BTA	Differential Voltage Probe	DVP-BTA
Electrode Amplifier	EA-BTA	Photogate	VPG-BTD	Voltage Probe	VP-BTA
Flow Rate Sensor	FLO-BTA	Radiation Monitor (Digital)	DRM-BTD	NEW 30-Volt Voltage Probe	30V-BTA

Go!LINK VERNIER

USB Interface

A quick and affordable way to get started with data-collection technology.

- Single-channel interface connects any one of 50 Vernier sensors to your computer's USB port. (See list of sensors.)
- Dozens of experiments from our popular lab books can be conducted using Go!Link.

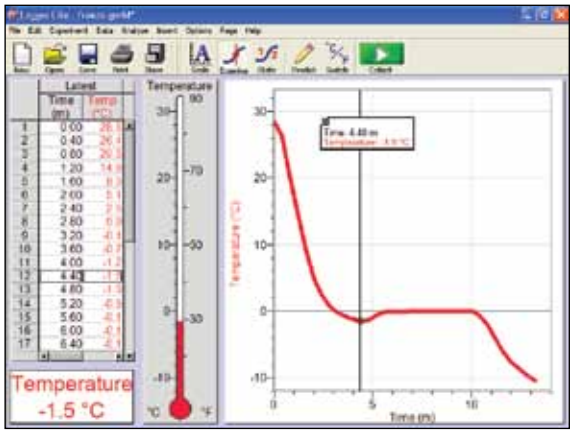
Go!Link, ORDER CODE **GO-LINK**

Includes Logger Lite Software

Teacher Pack of 8 Go!Links, ORDER CODE **GL-TP**

Includes Logger Lite Software

FREE Logger Lite Software



Real-Time Graphing

Go!Link, Go!Temp and Go!Motion include Logger Lite software with purchase.

Rather than tell students that water changes state at 0°C, let them see it for themselves! You can also investigate magnetic fields, gravity, and force with hands-on exploration and activities to help reinforce scientific concepts.

- Collect data using one or more sensors
- Calculate statistics
- Store runs
- Annotate graphs
- Print graphs
- Write reports
- Easily export data and graphs
- And much more!

PROMETHEAN ACTIVBOARD ENABLED

Want to import experiment movies and synchronize data with video? You'll want Logger *Pro*.

Logger *Pro* 3

Logger *Pro* 3 software, ORDER CODE **LP**

For more advanced software features, buy just one copy—site license for **ALL school and students' personal computers** is included! See pp. 16–19 for details.

GO!LINK COMPATIBLE SENSORS

SENSOR	CODE	SENSOR	CODE	SENSOR	CODE
Accelerometers		Gas Pressure Sensor	GPS-BTA	Salinity Sensor	SAL-BTA
25-g Accelerometer	ACC-BTA	Hand Dynamometer	HD-BTA	Soil Moisture Sensor	SMS-BTA
Low-g Accelerometer	LGA-BTA	Hand-Grip Heart Rate Monitor	HGH-BTA	Sound Level Meter	SLM-BTA
NEW Anemometer	ANM-BTA	Instrumentation Amplifier	INA-BTA	Spirometer	SPR-BTA
Barometer	BAR-BTA	Ion-Selective Electrodes		Temperature Probes	
Blood Pressure Sensor	BPS-BTA	Ammonium Ion-Selective Electrode	NH4-BTA	Extra-Long Temperature Probe	TPL-BTA
Charge Sensor	CRG-BTA	Calcium Ion-Selective Electrode	CA-BTA	Infrared Thermometer	IRT-BTA
CO_2 Gas Sensor	CO2-BTA	Chloride Ion-Selective Electrode	CL-BTA	Stainless Steel Temperature Probe	TMP-BTA
Colorimeter	COL-BTA	Nitrate Ion-Selective Electrode	NO3-BTA	Surface Temperature Sensor	STS-BTA
Conductivity Probe	CON-BTA	Light Sensor	LS-BTA	Thermocouple	TCA-BTA
Current Probes		Magnetic Field Sensor	MG-BTA	Wide-Range Temperature Probe	WRT-BTA
Current Probe	DCP-BTA	NEW Melt Station	MLT-BTA	Turbidity Sensor	TRB-BTA
NEW High Current Sensor	HCS-BTA	O_2 Gas Sensor	O2-BTA	UVA Sensor	UVA-BTA
Dissolved Oxygen Probe	DO-BTA	ORP Sensor	ORP-BTA	UVB Sensor	UVB-BTA
Dual-Range Force Sensor	DFS-BTA	pH Sensor	PH-BTA	Voltage Probes	
EKG Sensor	EKG-BTA	pH Sensor, Tris-Compatible Flat	FPH-BTA	Differential Voltage Probe	DVP-BTA
Electrode Amplifier	EA-BTA	Relative Humidity Sensor	RH-BTA	Voltage Probe	VP-BTA
Flow Rate Sensor	FLO-BTA	Respiration Monitor Belt (Requires GPS-BTA)	RMB	NEW 30-Volt Voltage Probe	30V-BTA
Force Plate	FP-BTA				

Go!Temp

USB Temperature Probe

Go!Temp plugs directly into your computer's USB port without the need for an additional interface. This rugged, stainless-steel temperature probe will engage your students in hands-on science as they explore temperature investigations.

Go!Temp
ORDER CODE **GO-TEMP**
Includes Logger Lite Software

Teacher Pack of 8 Go!Temps
ORDER CODE **GT-TP**
Includes one copy of Logger Lite Software

Media & Methods AWARDS PORTFOLIO WINNER 2005

TECHNOLOGY & LEARNING WINNER 2004 Award of EXCELLENCE

MultiMedia & Internet@Schools

Go!Motion

USB Motion Detector

- Teach important concepts in physics and physical science, such as position, velocity, and acceleration.
- Study the motion of a ball tossed in the air or a cart on a ramp.
- Engage your students with hands-on activities.

Go!Motion
ORDER CODE **GO-MOT**
Includes Logger Lite Software

Technology & Learning WINNER 2005 Award of EXCELLENCE

Teacher Pack of 8 Go!Motions
ORDER CODE **GO-MOT-TP**
Includes one copy of Logger Lite Software

Head pivots to align with your experiment.

Sensitivity switch optimizes data collection to suit your apparatus.

Connects directly to a USB port. (USB cable included.)

MORE ONLINE
Go!Motion can also be used with Logger *Pro* software. Go!Motion can be used with LabPro, LabQuest, LabQuest Mini, CBL 2, or a TI graphing calculator. Visit our web site for more information at **www.vernier.com/gomotion**

Go! Quick-Start Package

Includes:

- Go! Link interface and FREE Logger Lite Software
- Our award-winning Go!Temp USB temperature probe
- A TI Light Probe for measuring light intensity

ORDER CODE
GO-QSP

Logger *Pro* 3

Real-Time Graphing and Powerful Analytical Tools

Logger *Pro* is our flagship data-collection and analysis application for Windows and Mac. With the complete suite of data collection and analysis tools, Logger *Pro* is suitable for all students, beginning to advanced.

Don't need all this power, or working with younger students? Logger Lite, a streamlined subset of Logger *Pro*, is included free with every LabQuest, LabQuest Mini, Go!Temp, Go!Link and Go!Motion.

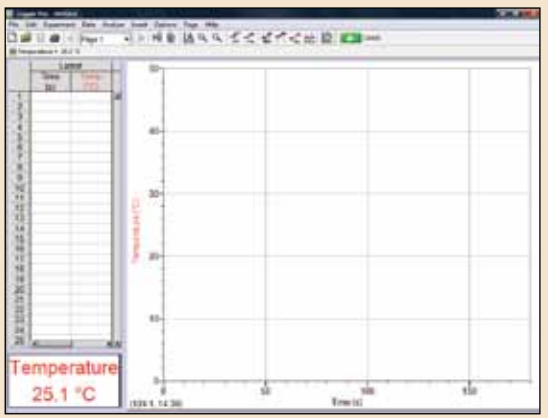
- Logger *Pro* is the most popular data-collection program in science education. Why? Teachers tell us that students find our software to be very easy and intuitive to use.
- One program does it all for all of your computers AND your students' personal computers.
- Think of Logger *Pro* as the digital data hub of your classroom and lab. It can gather data from a variety of sources, including LabQuest, LabQuest Mini, LabPro, Go! devices, Ohaus balances, compatible TI graphing calculators, spectrometers, GPS units, manual entry, and more.

AWARD-WINNING

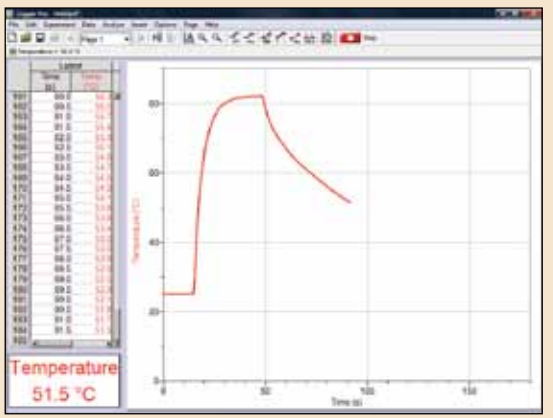
GREAT VALUE

Logger *Pro* 3 ORDER CODE **LP**

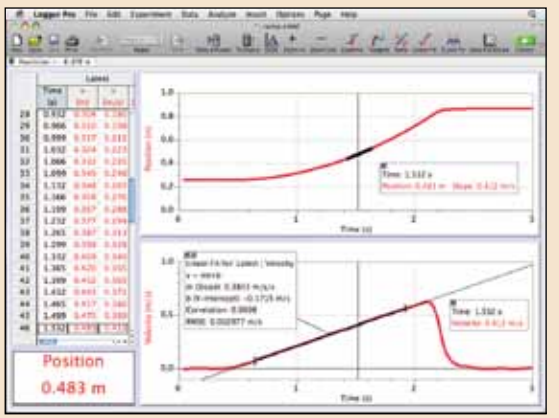
- Logger *Pro* 3 includes a site license for your entire school or college department.
- Site license includes home computers of faculty.
- Site license includes home computers of students—let them take it home!
- No need to count computers to satisfy licensing.
- Logger *Pro* 3 updates are free.



Logger Pro *at first launch with a temperature sensor. Graph, data table, and meter—all ready to go. Click Collect, and you're taking data.*



After you click Collect, Logger Pro *draws the graph in real time, and the data table and digital meter update continuously.*

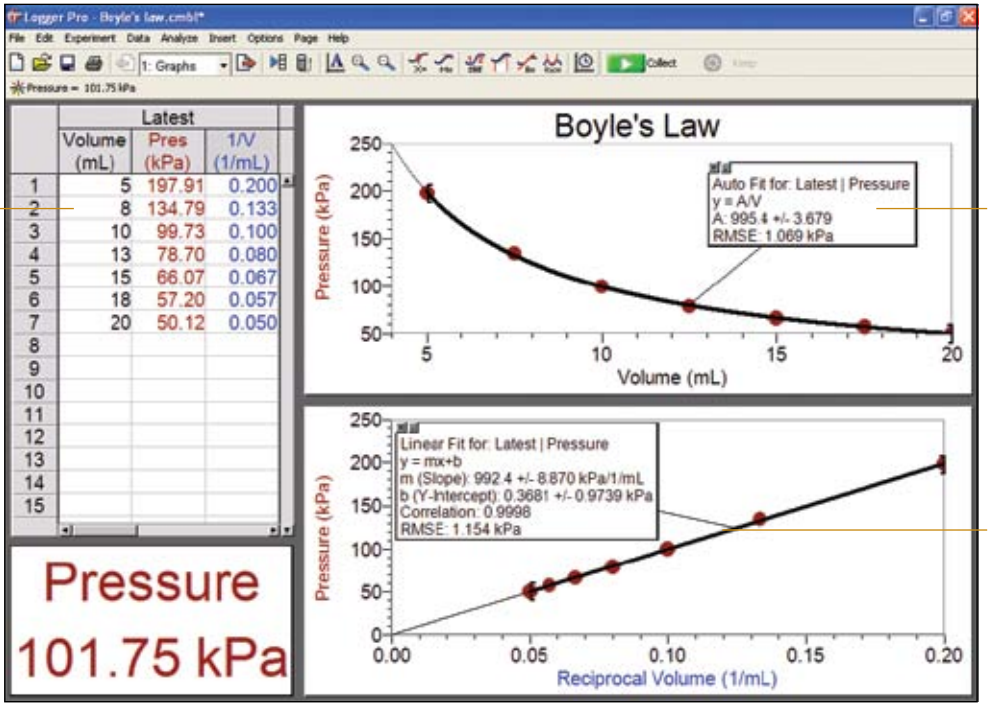


Draw tangent lines to find local slopes, fit lines to selected regions—the analysis tools you need are at your fingertips in Logger Pro.

Basic Features

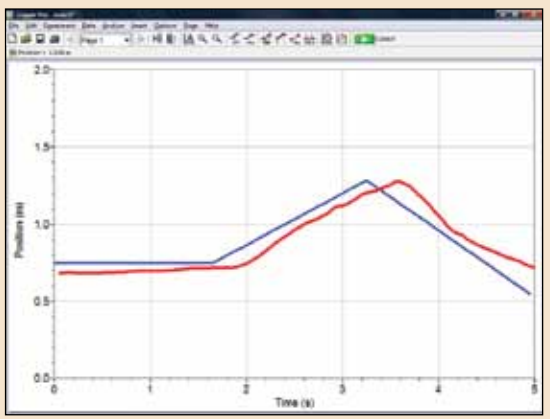
- Ease of use: connect a sensor, launch Logger *Pro*, and click Collect. Auto-ID sensors make setup effortless.
- Collect live data from more than 80 different sensors and devices.
- Draw predictions on a graph before collecting data.
- Use a variety of data-collection modes as needed for your experiment: time-based data, selected events, events with typed-in entries, photogate, radiation counting, and more.
- Manually enter data for graphing and analysis. All of the functions of Vernier's popular Graphical Analysis program are available in Logger *Pro*.
- Import data from LabQuest and calculators.
- Lay out graphs, tables, and text as needed across multiple pages to describe your experiment.
- Read values and slope from graphs using examine and tangent line tools.
- Print graphs and data tables.

See data presented in many ways: tables, graphs, curve fits, and more.

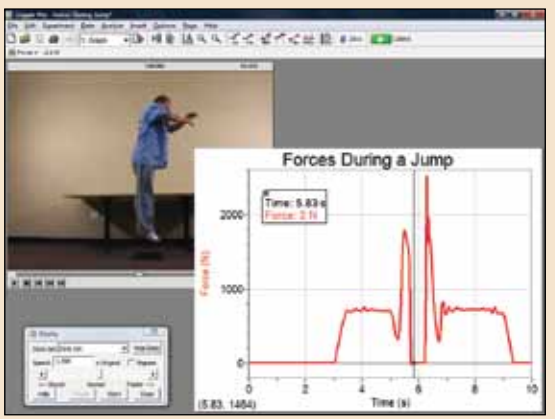


Curve fits show uncertainties in fit parameters. Choose from a library of built-in functions or enter your own.

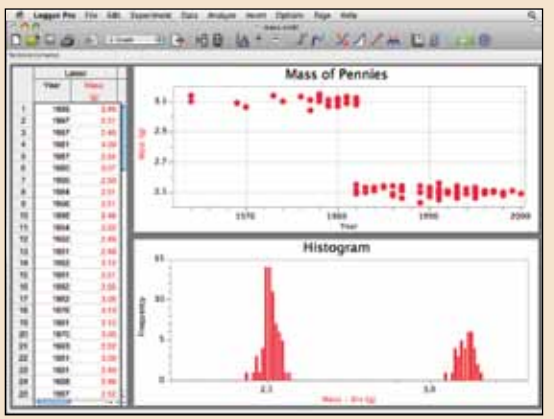
Replot data to show new relationships.



Logger Pro *will automatically create target graphs for graph-matching exercises.*

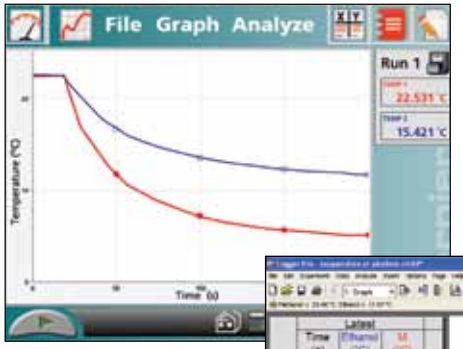


Synchronize videos to sensor data.

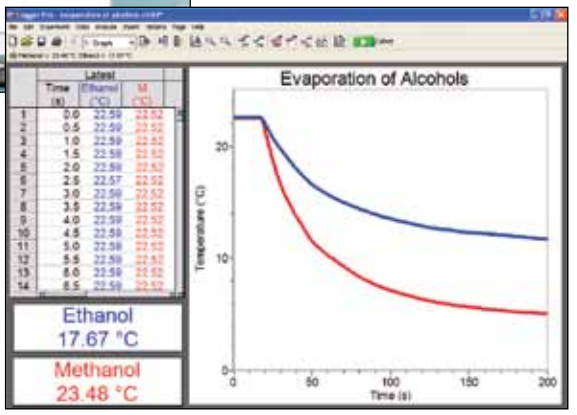


Logger Pro *has all the features of Graphical Analysis. Type or paste in data from other places and use all the analysis features in Logger* Pro.

Easily download your data from the LabQuest to a computer for further analysis with Logger *Pro* software.



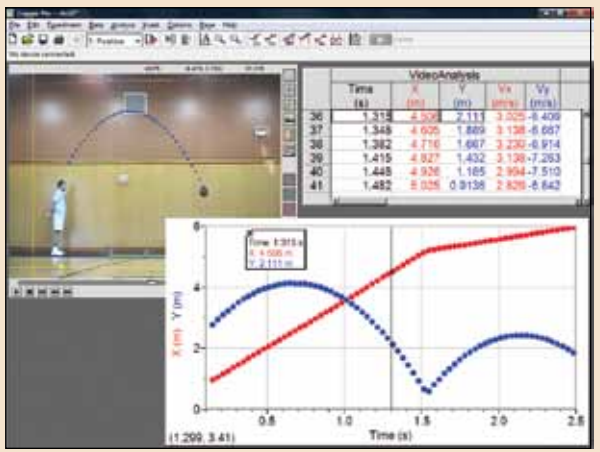
LabQuest



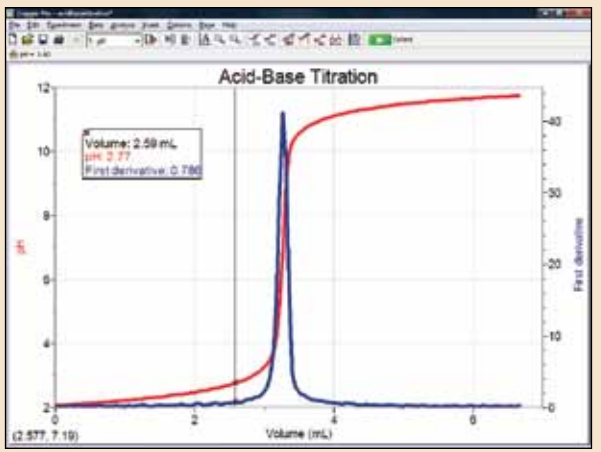
Logger Pro

Advanced Features

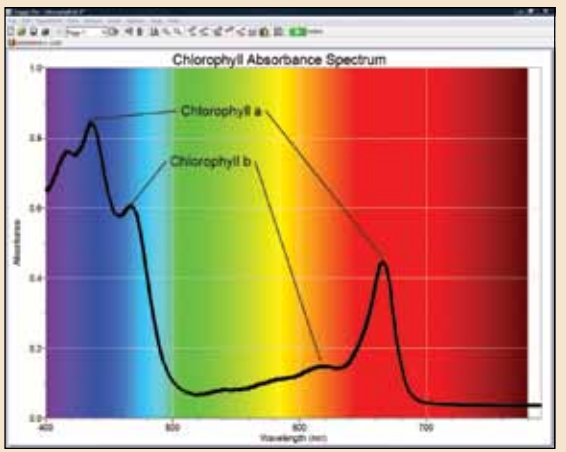
- Graph data in a variety of ways, including XY graphs, log graphs, double-Y graphs, strip charts, and FFT graphs.
- Model data with user-adjustable functions.
- Extract data from movies using frame-by-frame video analysis.
- Capture videos from DV cameras and web cameras.
- Play back movies synced to sensor data.
- Gel electrophoresis analysis.
- Calculated columns allow you to graph new quantities such as kinetic energy.
- Time of day and date stamps for graphing.
- Ocean Optics spectrometer support.
- GPS support.
- GC peak analysis.
- Manual configuration mode for IB courses.



Analyze videos to study two-dimensional motion. This is worth the price of Logger Pro *alone!*



Create double-Y graphs to tell complex stories simply.



Collect absorbance data from the Vernier Spectrometer, Ocean Optics spectrometers, or Vernier SpectroVis Plus.

LOGGER *PRO* IS COMPATIBLE WITH:

	Vernier LabQuest	Collect live data from LabQuest, retrieve existing data, or open saved files on LabQuest. Compatible with 71 different sensors.		**Digital Bioimaging Systems / ProScope HR**	Capture images and study DNA with Logger *Pro*'s gel analysis feature.
	Vernier LabQuest Mini	Connect a LabQuest Mini and use 58 different sensors.		**Vernier Mini GC**	Collect and analyze GC data with peak analysis features.
	Vernier LabPro	Connect a LabPro to collect data with 59 sensors.		**TI Graphing Calculators**	Use a TI Connectivity Cable to import data into Logger *Pro* from any supported TI graphing calculators.
	Go!Temp **Go!Link** **Go!Motion**	Connect any of our Go! sensors and get advanced analysis tools in Logger *Pro*.		**Vernier GPS Sensor**	Import longitude and latitude from GPS receivers.
	Wireless Dynamics Sensor System	See real-time graphing of acceleration, force, and altitude data via wireless Bluetooth connection.		**Video Clips**	Capture video clips and synchronize with sensor data or perform video analysis.
	Spectrometers	Collect data directly from Ocean Optics spectrometers and Vernier SpectroVis Plus.		**Manual Entry**	Enter data manually, do further analysis, or write lab reports.

Logger *Pro* is great for YOUR students

Logger *Pro* is great for high school students

- Calculated columns allow graphing of derived data; for example, plot the square of the pendulum length for one axis
- Modeling feature lets students superimpose mathematical functions on their data

Logger *Pro* is great for middle school students

- Easy unit switching helps teach measurement units
- Data export to InspireData™
- Time-of-day graphs for weather or other long-term studies

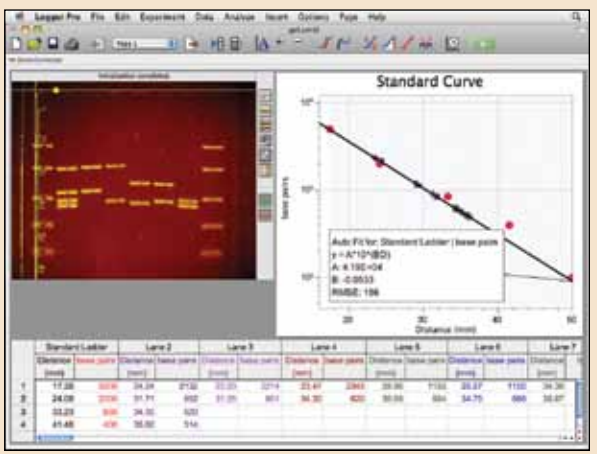
Logger *Pro* is great for college students

- Includes advanced graphing features like log graphs and semi-log graphs
- Custom curve fits allow sophisticated models
- Compatible with advanced Ocean Optics spectrometers

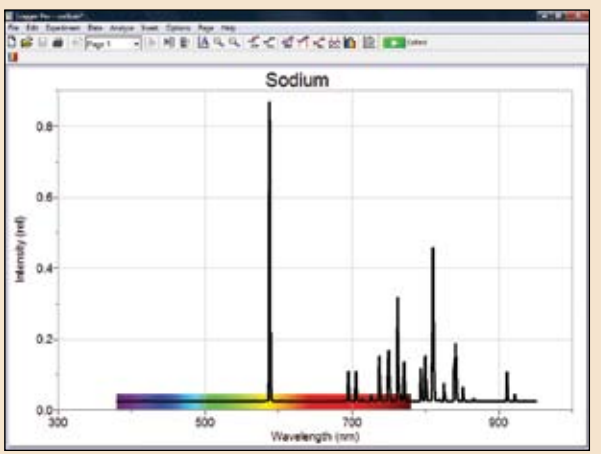
Logger *Pro* 3, ORDER CODE **LP**
One CD for Mac OS X and Windows

Logger *Pro* Student 5-Pack, ORDER CODE **LP-ST5**

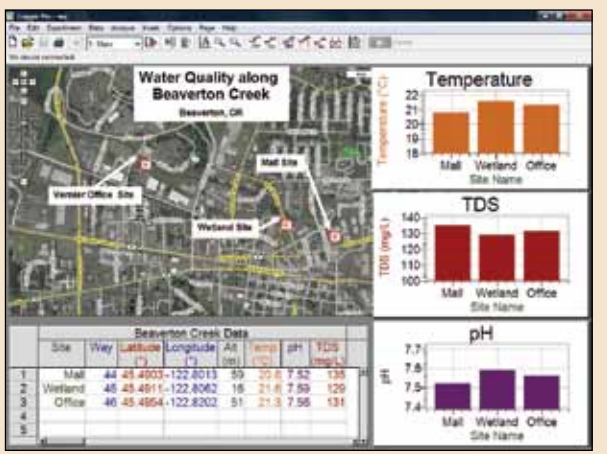
See www.vernier.com/loggerpro
for upgrade and system compatibility information



Use one of our digital bioimaging systems, along with Logger Pro*, to analyze gel electrophoresis data.*



Use the Ocean Optics Red Tide Spectrometer to study emission lines from discharge lamps.



Export water quality data to Google Maps and incorporate the result into a Logger Pro *page.*

NEW Vernier Video Physics App

Available on the App Store

Do Video Analysis on the iPhone®, iPod touch® and iPad™ Mobile Digital Devices

Now you can take the video analysis power of Logger *Pro* out in the field. We even took the app to a baseball game and analyzed a pitch on the spot.

Start with one of your own videos, take a new one, or use one of our sample videos. Track an object using our novel multi-touch cursor and set the video scale. View graphs of the trajectory, position, and velocity as a function of time.

If you want, you can set the origin to whatever works with your experiment. You can also rotate the coordinate system, as needed.

Once you've finished analysis, you can send your work to Logger *Pro* for further analysis or printing. Your completed videos are stored within the app for later reference.

What motion will you analyze?

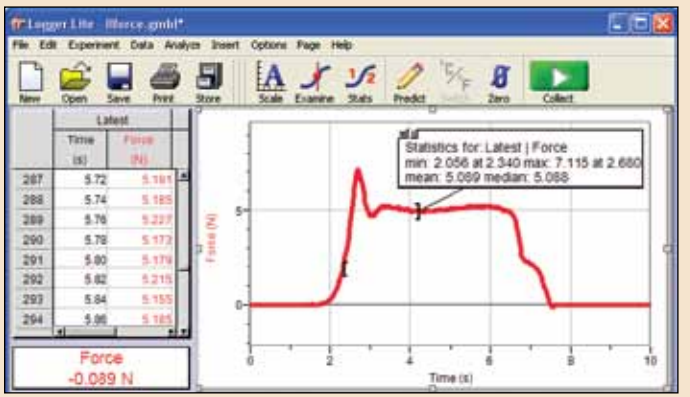
Video Physics requires iOS 4. For more info, visit www.vernier.com/videophysics

iPad photo courtesy of Apple

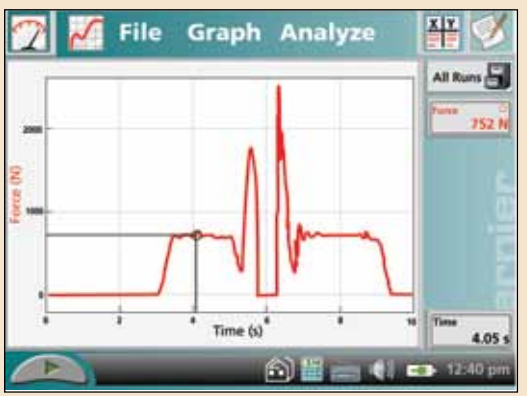
Collect Science Data with a Netbook

- Is your school using netbooks? Collect data with them. You can use a variety of Vernier equipment and software with most netbooks. For updated compatibility details, see www.vernier.com/netbooks
- Use netbooks with most Vernier interfaces. Go!Link, Go!Temp, or Go!Motion are excellent options, as is the LabQuest Mini. See page 14 for Go!Link, and pp. 12–13 for the LabQuest Mini.

Download **FREE** Vernier software for netbooks at www.vernier.com/netbooks



Logger Lite fits the small netbook screen.



LabQuest App runs on ASUS Eee PC and OLPC netbooks.

Experiment 31C from **Biology with Vernier,** ***"Photosynthesis and Respiration"***

BIOLOGY

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1 IT ALL STARTS WITH CURRICULUM

Want to save time? Start with a Vernier lab book. Aligned to state and national science standards, our lab books contain experiments for LabQuest, computers, and TI graphing calculators.

2 CHOOSE YOUR INTERFACE

Vernier LabQuest – LabQuest is our color, touch-screen interface. Use it as a standalone device or as a computer interface. More details on pp. 5–11.

LabQuest Mini – LabQuest Mini is a low-cost computer solution with five sensor ports. More details on pp. 12–13.

Vernier LabPro – For data collection with TI graphing calculators, see details on pp. 92–93.

3 CHOOSE YOUR SENSORS

Choose from Vernier's recommended packages or build your own from our list of sensors.

Our Deluxe Package contains all the sensors needed to perform every experiment in our biology lab book.

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This award-winning software is the best value around! Includes a site license for all computers in your school or your college department, as well as students' personal computers. See pp. 16–19 for details.

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BWV

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www.vernier.com/studenteditions

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- Essential teacher information.
- 31 ready-to-use student versions of Logger *Pro* experiments in print; LabQuest, computer, and calculator versions on CD.
- A generous site license. Buy one book and duplicate labs for your class.
- Easily edit labs to meet your personal teaching style using Microsoft® Word® files for all versions of the experiments on CD.
- Suggested answers, sample data, and graphs.
- Complete equipment and supplies list.

Features listed above are only available when you purchase the lab book. They are not available in the downloadable evaluation PDF.

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Biology with Vernier lab book contains the following experiments:

USING TEMPERATURE PROBES
- Biodiversity and Ecosystems
- Energy in Food
- Aerobic Respiration
- Dissolved Oxygen in Water
- Watershed Testing
- Physical Profile of a Lake

USING A GAS PRESSURE SENSOR
- Testing Catalase Activity
- Transpiration
- Cell Respiration
- Sugar Fermentation
- Effect of Temperature on Fermentation
- Osmosis
- Lactase Action
- Control of Human Respiration

USING AN EKG SENSOR
- Monitoring EKG

USING A HEART RATE MONITOR
- Heart Rate and Physical Fitness
- Ventilation and Heart Rate

USING A CO_2 GAS SENSOR
- Cell Respiration
- Respiration of Sugars by Yeast
- Effect of Temperature on Respiration
- Temperature of Cold-Blooded Organisms
- Lactase Action
- Photosynthesis and Respiration

USING A COLORIMETER
- Photosynthesis
- Alcohol & Biological Membranes
- Biological Membranes
- Population Dynamics

USING A RESPIRATION MONITOR BELT
- Control of Human Respiration

USING AN O_2 GAS SENSOR
- Photosynthesis and Respiration
- Enzyme Action
- Cell Respiration
- Oxygen Gas and Human Respiration
- Cold-Blooded Organisms

USING A CONDUCTIVITY PROBE
- Limitations on Cell Size
- Diffusion through Membranes
- Conducting Solutions
- Watershed Testing
- Physical Profile of a Lake

USING A DISSOLVED OXYGEN PROBE
- Interdependence of Plants and Animals
- Aerobic Respiration
- Dissolved Oxygen in Water
- Watershed Testing
- Physical Profile of a Lake
- Primary Productivity

USING A pH SENSOR
- Acids and Bases
- Interdependence of Plants and Animals
- Acid Rain
- Watershed Testing
- Physical Profile of a Lake

STARTER PACKAGES DELUXE PACKAGES VIDEO ONLINE

Biology LabQuest and LabQuest Mini Packages

Purchase one package per lab group (2–4 students) OR BUILD YOUR OWN PACKAGE from the list of recommended sensors below.

Standalone or Computer

LabQuest Interface & Sensors	CODE	Starter Package LQ-BIO-ST	Deluxe Package LQ-BIO-DX
Vernier LabQuest Interface	LABQ	✔	✔
Stainless Steel Temperature Probe	TMP-BTA	✔	✔
Hand-Grip Heart Rate Monitor	HGH-BTA	✔	✔
Gas Pressure Sensor	GPS-BTA	✔	✔
CO_2 Gas Sensor	CO2-BTA	✔	✔
O_2 Gas Sensor	O2-BTA		✔
BioChamber 250	BC-250		✔
Conductivity Probe	CON-BTA		✔
pH Sensor	PH-BTA		✔
Colorimeter	COL-BTA		✔
Dissolved Oxygen Probe	DO-BTA		✔
EKG Sensor	EKG-BTA		✔
Respiration Monitor Belt	RMB		✔

LABQUEST BIOLOGY PACKAGE

You will also need:

Biology with Vernier **lab book,** ORDER CODE **BWV**
See previous page.

Logger *Pro* 3 software, ORDER CODE **LP**
Buy just one copy—site license for ALL school and students' personal computers is included! See pp. 16–19 for details.

Computer Only

LabQuest Mini Interface & Sensors	CODE	Starter Package LM-BIO-ST	Deluxe Package LM-BIO-DX
Vernier LabQuest Mini Interface	LQ-MINI	✔	✔
Stainless Steel Temperature Probe	TMP-BTA	✔	✔
Hand-Grip Heart Rate Monitor	HGH-BTA	✔	✔
Gas Pressure Sensor	GPS-BTA	✔	✔
CO_2 Gas Sensor	CO2-BTA	✔	✔
O_2 Gas Sensor	O2-BTA		✔
BioChamber 250	BC-250		✔
Conductivity Probe	CON-BTA		✔
pH Sensor	PH-BTA		✔
Colorimeter	COL-BTA		✔
Dissolved Oxygen Probe	DO-BTA		✔
EKG Sensor	EKG-BTA		✔
Respiration Monitor Belt	RMB		✔

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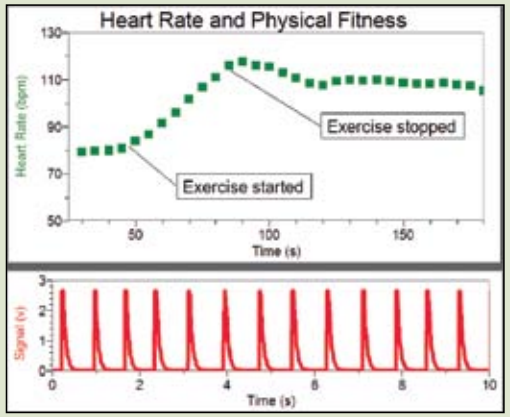
Biology with Vernier **lab book,** ORDER CODE **BWV**
See previous page.

Logger *Pro* 3 software, ORDER CODE **LP**
Buy just one copy—site license for ALL school and students' personal computers is included! See pp. 16–19 for details.

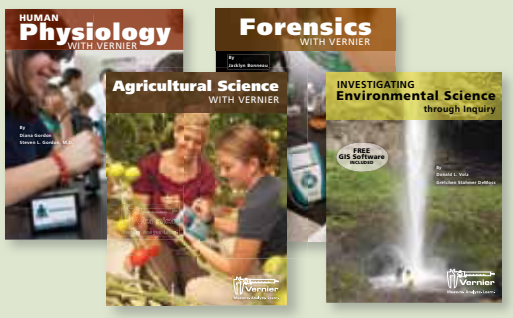
FOR TI CALCULATOR-BASED DATA COLLECTION: see pp. 94–100

AP* Biology Experiment 10: Heart Rate and Physical Fitness



Using a Hand-Grip Heart Rate Monitor to determine how exercise affects heart rate.

MORE ONLINE
For a complete correlation of Vernier labs with AP biology lab objectives, visit www.vernier.com/ap



Interested in Environmental Science, Agricultural Science, Human Physiology, or Forensics lab books? See pp. 86-90

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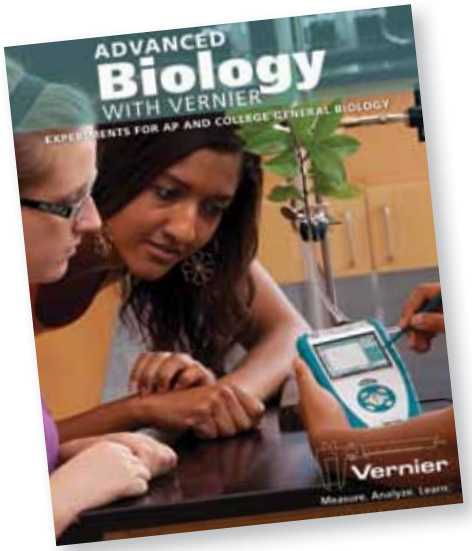

GREAT VALUE

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BIO-A

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Vernier lab books are loaded with teacher tips, sample graphs, and more. When you buy the lab book you will receive:

- Essential teacher information.
- 17 ready-to-use student versions of Logger *Pro* experiments in print; LabQuest, computer, and calculator versions on CD.
- A generous site license. Buy one book and duplicate labs for your class.
- Easily edit labs to meet your personal teaching style using Microsoft® Word® files for all versions of the experiments on CD.
- Suggested answers, sample data, and graphs.
- Complete equipment and supplies list.

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Advanced Biology with Vernier **lab book contains the following experiments, including all 12 recommended AP* Biology labs:**

USING A TEMPERATURE PROBE
- Dissolved Oxygen in Water

USING A GAS PRESSURE SENSOR
- Transpiration
- Cell Respiration
- Osmosis
- Enzyme Action

USING A CO_2 GAS SENSOR
- Cell Respiration

USING AN O_2 GAS SENSOR
- Enzyme Action
- Cell Respiration

USING A HEART RATE MONITOR
- Heart Rate and Physical Fitness

USING A COLORIMETER OR SPECTROVIS® PLUS SPECTROMETER
- Enzyme Analysis using Tyrosinase
- Introduction to Neurotransmitters using AChE
- Macromolecules: Experiments with Protein
- Photosynthesis

USING A CONDUCTIVITY PROBE
- Diffusion through Membranes

USING A DISSOLVED OXYGEN PROBE
- Dissolved Oxygen in Water

USING A SPECTROVIS PLUS SPECTROMETER
- Visible Spectra of Plant Pigments
- Determination of Chlorophyll in Olive Oil
- Enzyme Analysis using Tyrosinase
- Introduction to Neurotransmitters using AChE
- Macromolecules: Experiments with Protein

USING A BLOOD PRESSURE SENSOR
- Blood Pressure as Vital Sign

(USING BIOIMAGING SYSTEMS)
- Easy Transformation of *E. coli* using pGLO
- Analysis of Precut Lambda DNA: An Introduction to Restriction Enzymes
- Forensic DNA Fingerprinting

NO SENSOR USED
- Mitosis and Meiosis
- Genetics of Drosophila
- Population Genetics and Evolution
- Animal Behavior

VIDEO ONLINE

Did you know?

New IB Standards** All IB Group 4 experimental science courses now require students to use sensors for data logging in an experiment and software for graph plotting. For IB correlations to Vernier books, **visit** www.vernier.com/ib

** The IB Diploma Program is an official program of the International Baccalaureate Organization (IBO) which authorizes schools to offer it. The material available here has been developed independently of the IBO and is not endorsed by it.

Advanced Biology LabQuest and LabQuest Mini Packages

Purchase one package per lab group (2–4 students) OR BUILD YOUR OWN PACKAGE from the list of recommended sensors below.

Standalone or Computer

LabQuest Interface & Sensors		CODE	Colorimeter Deluxe LQ-ABIO-DX	SpectroVis Plus Deluxe LQ-AB-SV
Vernier LabQuest Interface		LABQ	✔	✔
Stainless Steel Temperature Probe		TMP-BTA	✔	✔
Gas Pressure Sensor		GPS-BTA	✔	✔
CO_2 Gas Sensor		CO2-BTA	✔	✔
O_2 Gas Sensor		O2-BTA	✔	✔
Conductivity Probe		CON-BTA	✔	✔
Dissolved Oxygen Probe		DO-BTA	✔	✔
Hand-Grip Heart Rate Monitor		HGH-BTA	✔	✔
Blood Pressure Sensor		BPS-BTA	✔	✔
BioChamber 250		BC-250	✔	✔
CHOOSE ONE	Colorimeter **or**	COL-BTA	✔	—
	SpectroVis Plus	SVIS-PL	—	✔

You will also need:

Advanced Biology with Vernier **lab book**
ORDER CODE **BIO-A** See previous page.

Logger *Pro* 3 software, ORDER CODE **LP**
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LABQUEST | ADVANCED BIOLOGY **COLORIMETER** PACKAGE | ADVANCED BIOLOGY **SPECTROVIS PLUS** PACKAGE

Computer Only

LabQuest Mini Interface & Sensors		CODE	Colorimeter Deluxe LM-ABIO-DX	SpectroVis Plus Deluxe LM-AB-SV
Vernier LabQuest Mini Interface		LQ-MINI	✔	✔
Stainless Steel Temperature Probe		TMP-BTA	✔	✔
Gas Pressure Sensor		GPS-BTA	✔	✔
CO_2 Gas Sensor		CO2-BTA	✔	✔
O_2 Gas Sensor		O2-BTA	✔	✔
Conductivity Probe		CON-BTA	✔	✔
Dissolved Oxygen Probe		DO-BTA	✔	✔
Hand-Grip Heart Rate Monitor		HGH-BTA	✔	✔
Blood Pressure Sensor		BPS-BTA	✔	✔
BioChamber 250		BC-250	✔	✔
CHOOSE ONE	Colorimeter **or**	COL-BTA	✔	—
	SpectroVis Plus	SVIS-PL	—	✔

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Advanced Biology with Vernier **lab book**
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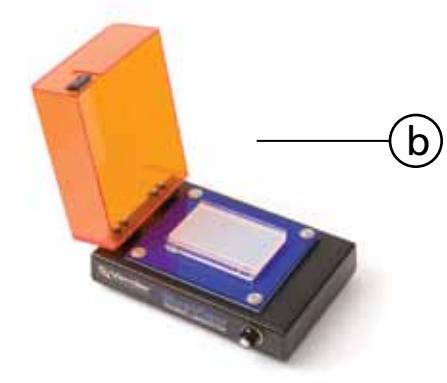
LABQUEST MINI | ADVANCED BIOLOGY **COLORIMETER** PACKAGE | ADVANCED BIOLOGY **SPECTROVIS PLUS** PACKAGE

FOR TI CALCULATOR-BASED DATA COLLECTION: see pp. 94–100



MORE ONLINE
More information at
www.vernier.com/biotech

a. Blue Digital Bioimaging System

ORDER CODE **BL-DBS**

The Blue Digital Bioimaging System is a complete solution for photodocumenting and analyzing your electrophoresis gels. With it, you can

- View your gel banding patterns using the BlueView Transilluminator.
- Capture a photograph of the gel on your computer using a ProScope HR.
- Analyze your results by creating a standard curve and calculating the number of base pairs in each band using Logger *Pro* software (not included).

The Blue Digital Bioimaging System includes a BlueView Transilluminator, Imaging Hood, ProScope HR digital USB camera with 1–10X lens, and a ProScope Stand.

b. BlueView Transilluminator

ORDER CODE **BLUE-VIEW**

The BlueView Transilluminator uses super bright blue LEDs to illuminate electrophoresis gels stained with SYBR Safe stain. This combination is a safer alternative to ethidium bromide and a UV transilluminator. Includes the BlueView Transilluminator only.

- Accommodates gels up to 15 x 12 cm with a viewing area of 11 x 11 cm.
- Can be used with a variety of fluorescent stains.

c. Electrophoresis Stains

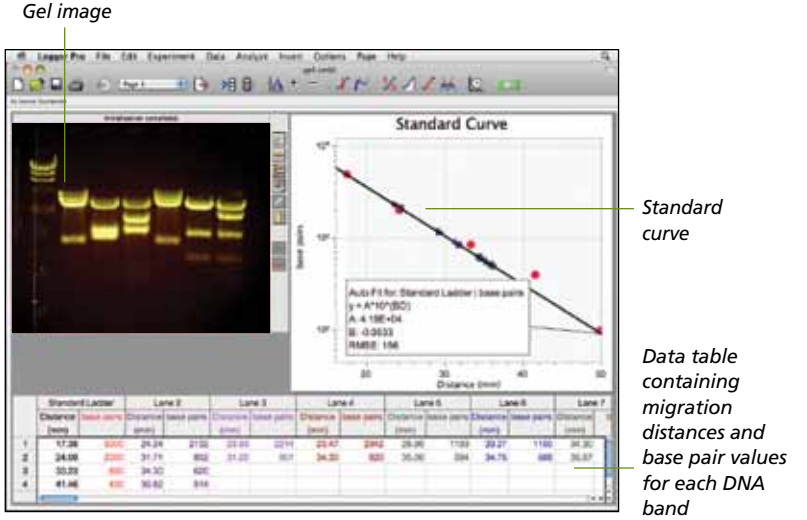
Less toxic than ethidium bromide, SYBR Safe works beautifully with the BlueView Transilluminator. SYBR Safe is available as a concentrate to be added to the agarose solution, or in a dilute form for post-electrophoresis staining. More information at www.vernier.com/biotech

Experiment 6B from Advanced Biology with Vernier, *"Analysis of Precut Lambda DNA"*

Three Easy Steps for Gel Analysis

Vernier provides tools for digital photodocumentation and analysis of gel electrophoresis. Here's how it's done:

1. Run your gel.
2. Use one of our Digital Bioimaging Systems to capture a digital photo of the gel in Logger *Pro*. Use Blue if using SYBR Safe stain or White if using Fast Blast™ DNA stain or methylene blue stain.
3. Use the Gel Analysis feature in Logger *Pro* to create a standard curve and determine the number of base pairs in each experimental band.


Gel image
Standard Curve
Standard curve
Data table containing migration distances and base pair values for each DNA band

Using Gel Analysis feature of Logger Pro *3*

Did you know?

Bio-Rad's Biotechnology Explorer™ kits and curricula are designed by teachers and scientists working together to integrate real-world biology topics and activities into existing biology curricula. Vernier's photodocumentation and analysis products are a perfect complement to Bio-Rad's research-quality laboratory equipment and supplies. Visit explorer.bio-rad.com for more information.

d. White Digital Bioimaging System

ORDER CODE **WHT-DBS**

The White Digital Bioimaging System is a complete solution for photodocumenting and analyzing non-fluorescent electrophoresis gels.

- View non-fluorescent gel banding patterns using the White Light Transilluminator.
- Capture a photograph of the gel on your computer using a ProScope HR.
- Analyze your results by creating a standard curve and calculating numbers of base pairs in each band using Logger *Pro* (not included).

The White Digital Bioimaging system includes a White Light Transilluminator, Imaging Hood, ProScope HR digital USB camera with 1–10X lens, and a ProScope Stand.

e. White Light Transilluminator

ORDER CODE **WHT-TRANS**

The White Light Transilluminator allows you to view gels stained with non-fluorescent, visible stains, such as Bio-Rad's Fast Blast™ DNA stain and methylene blue based stains.

Bio-Rad Partnership

Vernier and Bio-Rad have partnered to bring you the best in biotechnology kits, instrumentation, consumables, data collection, analysis, and curricula. The following Bio-Rad kits are used in the new edition of our lab book, *Advanced Biology with Vernier.* For more information, or to order these or other Bio-Rad products, contact Bio-Rad directly at explorer.bio-rad.com or 1-800-424-6723.

pGLO™ Bacterial Transformation Kit
(catalog number: 166-0003EDU)

Analysis of Precut Lambda DNA Kit
(catalog number: 166-0001EDU)

Forensic DNA Fingerprinting Kit
(catalog number: 166-0007EDU)

Got Protein?™ Kit
(catalog number: 166-2900EDU)

d

e

Bio-Rad Forensic DNA Fingerprinting Kit

a. Tris-Compatible Flat pH Sensor

ORDER CODE **FPH-BTA**

The Tris-Compatible Flat pH Sensor uses a double-junction electrode, making it compatible with Tris buffers and solutions containing proteins. The flat glass shape also makes it ideal for measuring the pH of semisolids, such as food or soil.

b. Vernier GPS Sensor

ORDER CODE **VGPS**

The Vernier GPS (Global Positioning System) Sensor collects location data such as latitude, longitude, and altitude right on your LabQuest or computer.

- Record your location as you measure water quality at various sites along a stream.
- Track location *vs.* sensor data, such as acceleration in a car or train.

c. Stir Station

ORDER CODE **STIR**

The Stir Station is a high-quality, multi-function magnetic stirrer. The speed can easily be fine-tuned to achieve the desired effect.

- Has a built-in ring stand.
- Runs on batteries or AC power.
- Includes Vernier Microstirrer and traditional stir bar.
- Temperature Probe and Electrode Support shown, but not included.

d. BioChambers

2000 mL, ORDER CODE **BC-2000**
250 mL, ORDER CODE **BC-250**

BioChambers provide a way for both CO_2 Gas and O_2 Gas sensors to be used at the same time in a closed system.

VERNIER GPS SENSOR
Connect directly to the USB port of your computer or LabQuest. See page 108 for more information.

SpectroVis® Plus

ORDER CODE
SVIS-PL

Spectrophotometer + Fluorometer

Having an array spectrometer/fluorometer combination is now affordable for each of your lab stations! SpectroVis Plus spectrophotometer plus fluorometer allows students to collect absorbance, transmittance, and fluorescence data quickly and easily. In absorbance mode, you can quickly and easily measure the absorbance spectrum of a solution, concentrations of solutions, and rates of reactions. With its two different excitation wavelengths, SpectroVis Plus can quantitatively measure the fluorescence spectra of many compounds, such as chlorophyll, fluorescein, GFP, and more. Connect SpectroVis Plus to a LabQuest or a computer running Logger *Pro* using a standard USB cable (included), and see the results in full color.

USES

- Measure absorbance spectrum of a liquid
- Measure fluorescence emission spectrum of a liquid
- Conduct Beer's law investigations
- Conduct kinetic studies of absorbance *vs.* time
- Conduct equilibrium studies of absorbance *vs.* time and/or absorbance *vs.* concentration
- Conduct experiments on enzyme kinetics
- Perform colorimetric or fluorescent bioassays
- Measure emissions of gas discharge tubes or other light sources using the SpectroVis Optical Fiber (not included)

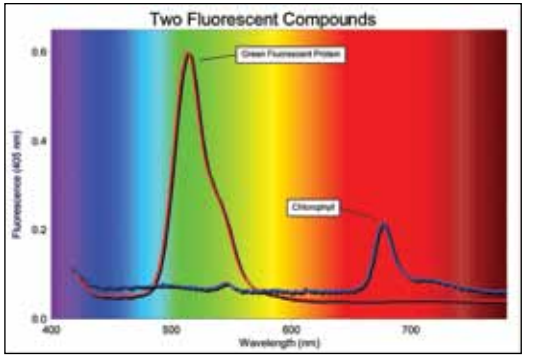
FEATURES

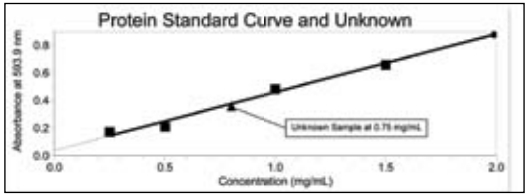
- Portable: 15 cm x 9 cm x 4 cm
- Easy one-step calibration
- Measures absorbance over a 380–950 nm range
- ~2.5 nm optical resolution, 570 wavelengths, 1 nm reporting intervals
- Fluorescence excitation centered at 405 nm or 500 nm
- Powered by computer or LabQuest USB port; no additional power source needed

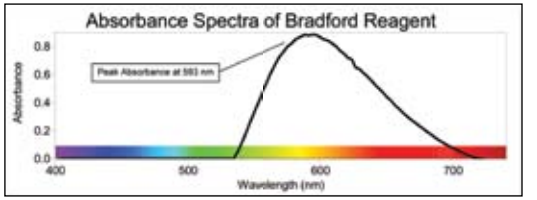
---

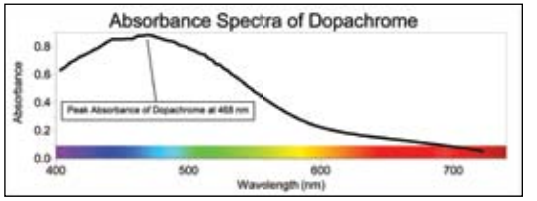
SpectroVis Optical Fiber, ORDER CODE SVIS-FIBER

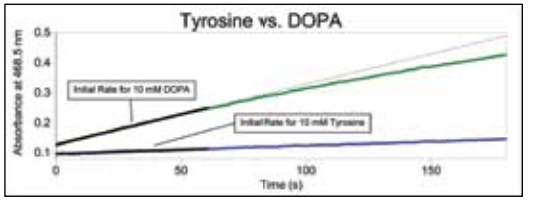
Turn your SpectroVis Plus into an emissions spectrometer using the SpectroVis Optical Fiber insert. Simply insert the unit into the cuvette holder and point the 1 m optical fiber at a light source.











Data from spectrometer labs in Advanced Biology with Vernier

ProScope HR™

high resolution handheld microscope

High-Resolution Handheld Microscope

The ProScope HR is a USB handheld digital microscope designed for use with your computer. With a high-quality CMOS and universal lens mount, the ProScope HR can become a powerful addition to any classroom.

- Instantly displays digital images on a computer screen.
- Takes still photos, movies, and time-lapse videos.
- Interchangeable lenses make it easy to get the magnification you need.
- Includes ProScope HR software and works with Logger *Pro*.
- Lens-mounted, white LEDs make lighting subjects simple.
- Lenses also sold separately on our web site at www.vernier.com/proscope

ProScope HR

ORDER CODE **BD-HRB**

Get started capturing high-resolution microscopic images of hair follicles, the ridges and troughs of your finger prints, and more with the 50X lens.

Includes: ProScope HR Unit, ProScope HR Software, and 50X Lens.

Biology ProScope HR Kit

ORDER CODE **BD-HRBIOL**

Use the ProScope HR as a dissecting microscope or attach the ProScope HR to your regular microscope for even more magnification.

Includes: ProScope HR Unit, ProScope HR Software, 50X Lens, 1-10X Lens, C-Mount Adapter with IR Cut Filter, Microscope Lens Tube Adapter, Camera Stand, Rugged Hard-Side Case

ProScope HR Deluxe Kit

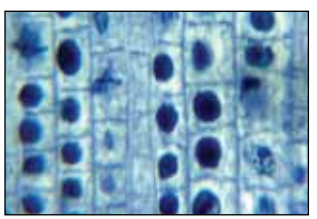
ORDER CODE **BD-DLX**

In addition to everything that comes with the Biology ProScope HR Kit, the Deluxe Kit includes two more lenses for maximum magnification at 100x or 200x.

Includes: ProScope HR Unit, ProScope HR Software, 50X Lens, 1-10X Lens, 100X Lens, 200X Lens, C-Mount Adapter with IR Cut Filter, Microscope Lens Tube Adapter, Camera Stand, Rugged Hard-Side Case.

Aphid

Gel electrophoresis



Onion root tip

Lily pollen grain

Use the ProScope HR as a dissecting scope to study insects

Connect the ProScope HR to a microscope for more powerful magnification

Higher resolution ProScope HR2 model also available. For details visit ***www.vernier.com/proscope***

Experiment 6 from* Chemistry with Vernier, *"Boyle's Law"

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1 IT ALL STARTS WITH CURRICULUM

Want to save time? Start with a Vernier lab book. Aligned to state and national science standards, our lab books contain experiments for LabQuest, computers, and TI graphing calculators.

Also recommended: *Investigating Chemistry through Inquiry* page 36.

2 CHOOSE YOUR INTERFACE

Vernier LabQuest – LabQuest is our color, touch-screen interface. Use it as a standalone device or as a computer interface. More details on pp. 5–11.

LabQuest Mini – LabQuest Mini is a low-cost computer solution with five sensor ports. More details on pp. 12–13.

3 CHOOSE YOUR SENSORS

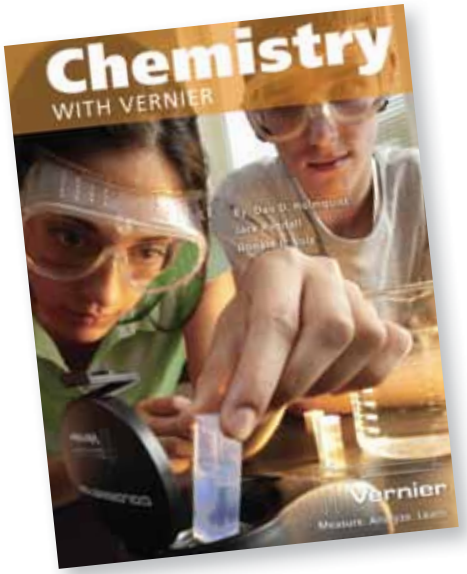
Choose from Vernier's recommended packages or build your own from our list of sensors.

Our Deluxe Package contains all the sensors needed to perform every experiment in our chemistry lab book.

Build custom packages online at www.vernier.com/guide

4 ADD A COPY OF LOGGER *PRO*

This award-winning software is the best value around! Includes a site license for all computers in your school or your college department, as well as students' personal computers. See pp. 16–19 for details.



GREAT VALUE

Purchase the Lab Book

ORDER CODE
CWV

Student Editions Available
www.vernier.com/studenteditions

Vernier lab books are loaded with teacher tips, sample graphs, and more. When you buy the lab book you will receive:

- Essential teacher information, including instructions for preparing solutions.
- 36 ready-to-use student versions of Logger *Pro* experiments in print; LabQuest, computer, and calculator versions on CD.
- A generous site license. Buy one book and duplicate labs for your class.
- Easily edit labs to meet your personal teaching style using Microsoft® Word® files for all versions of the experiments on CD.
- Suggested answers, sample data, and graphs.
- Complete equipment and supplies list.

Features listed above are only available when you purchase the lab book. They are not available in the downloadable evaluation PDF.

DOWNLOAD evaluation PDFs for all labs at www.vernier.com/labs

Chemistry with Vernier lab book contains the following experiments:

USING TEMPERATURE PROBES
- Endothermic and Exothermic Reactions
- Freezing and Melting of Water
- Another Look at Freezing Temperature
- Heat of Fusion of Ice
- Pressure-Temperature Relationships
- Fractional Distillation
- Evaporation and Intermolecular Attractions
- Vapor Pressure of Liquids
- Effect of Temperature on Solubility
- Finding Molecular Weight
- Energy Content of Foods
- Energy Content of Fuels
- Hess's Law
- Heat of Combustion: Magnesium

USING A pH SENSOR
- Household Acids and Bases
- Acid Rain
- Titration Curves of Acids and Bases
- ▶ Acid-Base Titration
- Titration of a Diprotic Acid
- Acid Dissociation Constant, K_a
- Time-Released Vitamin C Tablet
- The Buffer in Lemonade
- Phosphoric Acid Content in Soft Drinks
- Microscale Acid-Base Titration

USING A VOLTAGE PROBE
- Micro-Voltaic Cells
- Lead Storage Batteries

USING A GAS PRESSURE SENSOR
- Boyle's Law: Gas Pressure and Volume
- Pressure-Temperature Relationship
- Vapor Pressure of Liquids

USING A COLORIMETER
- ▶ Beer's Law
- Finding an Equilibrium Constant, K_c
- ▶ Rate Law Determination of the Crystal Violet Reaction
- Chlorine Content of Swimming Pool Water
- Quantity of Iron in a Vitamin Tablet

USING A CONDUCTIVITY PROBE
- Electrolytes and Non-Electrolytes
- The Effect of Concentration
- Using Conductivity to Find an Equivalence Point

USING A DROP COUNTER *(optional)*
- ▶ Acid-Base Titration
- Titration of a Diprotic Acid
- Using Conductivity to Find an Equivalence Point

USING NO SENSOR
- Find the Relationship: An Exercise in Graphical Analysis

STARTER PACKAGES DELUXE PACKAGES ▶ VIDEO ONLINE

Chemistry LabQuest and LabQuest Mini Packages

Purchase one package per lab group (2–4 students) OR BUILD YOUR OWN PACKAGE from the list of recommended sensors below.

Standalone or Computer

LabQuest Interface & Sensors	CODE	Starter Package LQ-CH-ST	Deluxe Package LQ-CH-DX
Vernier LabQuest Interface	LABQ	✔	✔
(2) Stainless Steel Temperature Probes	TMP-BTA	✔	✔
pH Sensor	PH-BTA	✔	✔
Gas Pressure Sensor	GPS-BTA	✔	✔
Voltage Probe	VP-BTA	✔	✔
Conductivity Probe	CON-BTA		✔
Colorimeter	COL-BTA		✔
Drop Counter	VDC-BTD		✔

LABQUEST **CHEMISTRY** PACKAGE

You will also need:

Chemistry with Vernier **lab book,** ORDER CODE **CWV**
See previous page.

Logger *Pro* 3 software, ORDER CODE **LP**
Buy just one copy—site license for ALL school and students' personal computers is included! See pp. 16–19 for details.

Computer Only

LabQuest Mini Interface & Sensors	CODE	Starter Package LM-CH-ST	Deluxe Package LM-CH-DX
Vernier LabQuest Mini Interface	LQ-MINI	✔	✔
(2) Stainless Steel Temperature Probes	TMP-BTA	✔	✔
pH Sensor	PH-BTA	✔	✔
Gas Pressure Sensor	GPS-BTA	✔	✔
Voltage Probe	VP-BTA	✔	✔
Conductivity Probe	CON-BTA		✔
Colorimeter	COL-BTA		✔
Drop Counter	VDC-BTD		✔

LABQUEST MINI **CHEMISTRY** PACKAGE

You will also need:

Chemistry with Vernier **lab book,** ORDER CODE **CWV**
See previous page.

Logger *Pro* 3 software, ORDER CODE **LP**
Buy just one copy—site license for ALL school and students' personal computers is included! See pp. 16–19 for details.

FOR TI CALCULATOR-BASED DATA COLLECTION: see pp. 94–100

Also recommended: *Investigating Chemistry through Inquiry.* See page 36.

We also recommend:

Chemistry with Vernier **lab book**

ORDER CODE
CWV

Includes 36 ready-to-use experiments. See page 30 for more detail. General Chemistry and AP Chemistry instructors will find additional advanced chemistry labs in this lab book.

Investigating Chemistry through Inquiry **lab book**

ORDER CODE
CHEM-I

This lab book, reviewed and recommended by NSTA, contains 25 inquiry-based chemistry investigations. If you are new to inquiry-based instruction, the extensive teacher section will help guide you through the inquiry-based style of chemistry instruction.

The AP Chemistry Course Description (Acorn) booklet describes 22 recommended chemistry experiments. In the *Advanced Chemistry with Vernier* lab book, we have included one lab for each of the 22 AP recommended experiments. These experiments are indicated by the letters "AP" in parentheses after the lab titles to the right. Visit www.vernier.com/ap for a complete correlation of Vernier labs with AP chemistry lab objectives.

GREAT VALUE

Purchase the Lab Book

ORDER CODE
CHEM-A

Student Editions Available
www.vernier.com/studenteditions

Vernier lab books are loaded with teacher tips, sample graphs, and more. When you buy the lab book, you will receive:

- Essential teacher information, including instructions for preparing solutions.
- 35 ready-to-use student versions of Logger *Pro* experiments in print; LabQuest, computer, and calculator versions on CD.
- A generous site license. Buy one book and duplicate labs for your class.
- Easily edit labs to meet your personal teaching style using Microsoft® Word® files for all versions of the experiments on CD.
- Suggested answers, sample data, and graphs.
- Complete equipment and supplies list.

Features listed above are only available when you purchase the lab book. They are not available in the downloadable evaluation PDF.

DOWNLOAD evaluation PDFs for all labs at **www.vernier.com/labs**

Advanced Chemistry with Vernier lab book contains the following experiments:

USING TEMPERATURE PROBES
- Using Freezing-Point Depression to Find Molecular Weight **(AP)**
- The Molecular Mass of a Volatile Liquid **(AP)**
- Molar Volume of a Gas **(AP)**
- Vapor Pressure and Heat of Vaporization
- Rate Determination and Activation Energy
- Synthesis and Analysis of Aspirin **(AP)**
- Exploring the Properties of Gases
- Determining the Mole Ratios in a Chemical Reaction **(AP)**
- Determining the Enthalpy of a Chemical Reaction **(AP)**
- Synthesis and Analysis of Alum **(AP)**
- The Enthalpy of Neutralization of Phosphoric Acid

USING A pH SENSOR
- Standardizing a Solution of Sodium Hydroxide **(AP)**
- Buffers **(AP)**
- Determining the K_{sp} of Calcium Hydroxide
- Determining K_a by the Half Titration of a Weak Acid

USING A COLORIMETER OR SPECTROVIS PLUS
- The Determination of an Equilibrium Constant **(AP)**
- Determining the Concentration of a Solution: Beer's Law **(AP)**
- The Rate and Order of a Chemical Reaction
- The Synthesis and Analysis of Aspirin **(AP)**
- Rate Determination and Activation Energy

USING A pH SENSOR AND DROP COUNTER
- Acid-Base Titration **(AP)**
- Investigating Indicators **(AP)**

USING A VOLTAGE PROBE
- Electrochemistry: Voltaic Cells **(AP)**

USING A GAS PRESSURE SENSOR
- The Decomposition of Hydrogen Peroxide **(AP)**
- The Molar Volume of a Gas **(AP)**
- Exploring the Properties of Gases
- Vapor Pressure and Heat of Vaporization

USING A CONDUCTIVITY PROBE & DROP COUNTER
- Conductimetric Titration and Gravimetric Determination **(AP)**
- The Base Hydrolysis of Ethyl Acetate

USING AN ORP SENSOR & DROP COUNTER
- An Oxidation-Reduction Titration: Fe^{2+} and Ce^{4+} **(AP)**
- Potentiometric Titration of Hydrogen Peroxide

CURRENT PROBE
- Electroplating **(AP)**
- Avogadro's Number

USING A RADIATION MONITOR
- Alpha, Beta, and Gamma
- Radiation Shielding
- Half-Life Determination

NO SENSOR USED
- The Determination of a Chemical Formula **(AP)**
- The Determination of the Percent Water in a Compound **(AP)**
- Separation and Qualitative Analysis of Cations **(AP)**
- Liquid Chromatography **(AP)**

VIDEO ONLINE

Advanced Chemistry LabQuest and LabQuest Mini Packages

Purchase one package per lab group (2–4 students) OR BUILD YOUR OWN PACKAGE from the list of recommended sensors below.

Standalone or Computer

LabQuest Interface & Sensors		CODE	Colorimeter Deluxe LQ-CHMA-DX	SpectroVis Plus Deluxe LQ-ACSV-DX
Vernier LabQuest Interface		LABQ	✔	✔
Stainless Steel Temperature Probe		TMP-BTA	✔	✔
pH Sensor		PH-BTA	✔	✔
Gas Pressure Sensor		GPS-BTA	✔	✔
Voltage Probe		VP-BTA	✔	✔
Conductivity Probe		CON-BTA	✔	✔
Drop Counter		VDC-BTD	✔	✔
Current Probe		DCP-BTA	✔	✔
ORP Sensor		ORP-BTA	✔	✔
Digital Radiation Monitor		DRM-BTD	✔	✔
CHOOSE ONE	**Colorimeter** or	COL-BTA	✔	—
	SpectroVis Plus	SVIS-PL	—	✔

You will also need:

Advanced Chemistry with Vernier **lab book**
ORDER CODE **CHEM-A** See previous page.

Chemistry with Vernier **lab book,** ORDER CODE **CWV**
(recommended) See page 32.

Logger *Pro* 3 software, ORDER CODE **LP**
Buy just one copy—site license for ALL school and students' personal computers is included! See pp. 16–19 for details.

LABQUEST | ADVANCED CHEMISTRY **COLORIMETER** PACKAGE | ADVANCED CHEMISTRY **SPECTROVIS PLUS** PACKAGE

Computer Only

LabQuest Mini Interface & Sensors		CODE	Colorimeter Deluxe LM-CHMA-DX	SpectroVis Plus Deluxe LM-ACSV-DX
Vernier LabQuest Mini Interface		LQ-MINI	✔	✔
Stainless Steel Temperature Probe		TMP-BTA	✔	✔
pH Sensor		PH-BTA	✔	✔
Gas Pressure Sensor		GPS-BTA	✔	✔
Voltage Probe		VP-BTA	✔	✔
Conductivity Probe		CON-BTA	✔	✔
Drop Counter		VDC-BTD	✔	✔
Current Probe		DCP-BTA	✔	✔
ORP Sensor		ORP-BTA	✔	✔
Digital Radiation Monitor		DRM-BTD	✔	✔
CHOOSE ONE	**Colorimeter** or	COL-BTA	✔	—
	SpectroVis Plus	SVIS-PL	—	✔

You will also need:

Advanced Chemistry with Vernier **lab book**
ORDER CODE **CHEM-A** See previous page.

Chemistry with Vernier **lab book,** ORDER CODE **CWV**
(recommended) See page 32.

Logger *Pro* 3 software, ORDER CODE **LP**
Buy just one copy—site license for ALL school and students' personal computers is included! See pp. 16–19 for details.

LABQUEST MINI | ADVANCED CHEMISTRY **COLORIMETER** PACKAGE | ADVANCED CHEMISTRY **SPECTROVIS PLUS** PACKAGE

FOR TI CALCULATOR-BASED DATA COLLECTION: see pp. 94–100

a

- *Three LEDs light up solutions*
- *Can be used with AC power or four C batteries*

b

c

d

a. *Investigating Chemistry through Inquiry*

ORDER CODE **CHEM-I**

If you love Vernier lab books, but want a stronger emphasis on inquiry for your student experiments, this book is for you. This lab book, reviewed and recommended by NSTA, contains 25 inquiry-based chemistry investigations. Each experiment includes a preliminary activity, teacher information, sample researchable questions, and sample data for those researchable questions. If you are new to inquiry-based instruction, the extensive teacher section will help guide you through the inquiry-based style of chemistry instruction.

For sample labs go to www.vernier.com/cmat/chemi.html

---

b. Stir Station, ORDER CODE STIR

The Stir Station is a high-quality, multi-function magnetic stirrer. It has a stirring capacity of 800 mL in a 1 L beaker. It works efficiently with beakers with a volume as small as 50 mL and with a wide range of sizes and shapes of magnetic stirring bars.

Includes Stir Station, Vernier Microstirrer (see page 106), magnetic stirring bar, AC power adapter, and removable ring-stand post. Can be used with AC power or batteries.

---

c. Electrode Support, ORDER CODE ESUP

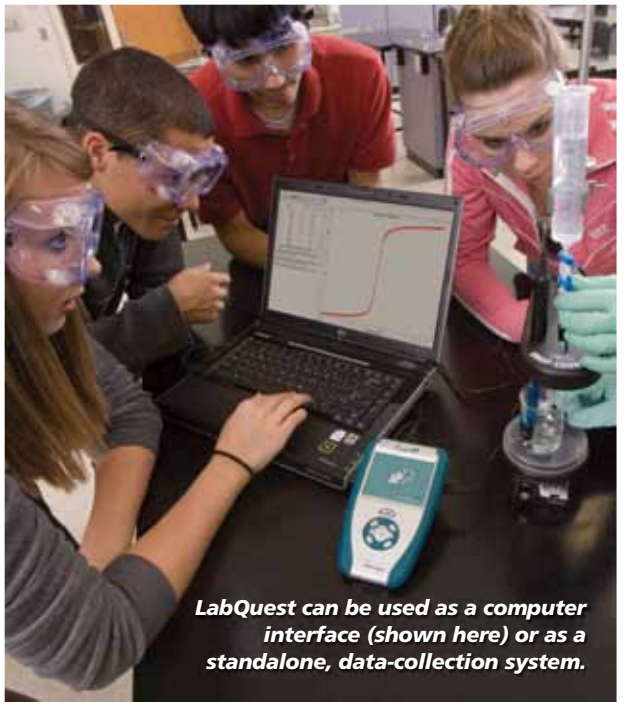
Our Electrode Support is a perfect holder for many sensors. It is built to connect to all standard ring-stand posts. The larger opening is perfect for our pH, ISE, Conductivity, and ORP sensors. The smaller opening is designed to hold our Stainless Steel Temperature Probe on the Vernier Go!Temp.

---

d. Vernier Drop Counter, ORDER CODE VDC-BTD

Titrations! The Vernier Drop Counter allow your students to conduct titrations precisely and effectively in less time.

- Vernier chemistry labs are customized for use with our Drop Counter.
- Use with the Vernier pH Sensor for acid-base titrations, Conductivity Probe for conductimetric titrations, and ORP Sensor for oxidation-reduction titrations.



LabQuest can be used as a computer interface (shown here) or as a standalone, data-collection system.

Did you know?

You can use our Electrode Amplifier with third-party pH electrodes that have BNC connectors, or purchase our pH Replacement Electrode.

Electrode Amplifier

ORDER CODE
EA-BTA

pH Replacement Electrode*

ORDER CODE
7120B

*Has a BNC connector to connect to EA-BTA (does not replace PH-BTA)

Products for Organic Chemistry

Interface & Sensors		CODE	LabQuest	LabQuest Mini
CHOOSE ONE	**LabQuest**	LABQ	✔	—
	LabQuest Mini (computer)	LQ-MINI	—	✔
Wide-Range Temperature Probe		WRT-BTA	✔	✔
Melt Station		MLT-BTA	✔	✔
SpectroVis Plus (VIS-NIR spectrometer)		SVIS-PL	✔	✔
Vernier Mini Gas Chromatograph		GC-MINI	✔	✔

Software:

Logger *Pro* 3 software, ORDER CODE **LP**
Buy just one copy—site license for ALL department and students' personal computers is included! See pp. 16–19 for details.

Organic Chemistry experiments: FREE download from www.vernier.com/organiclabs

NEW Melt Station

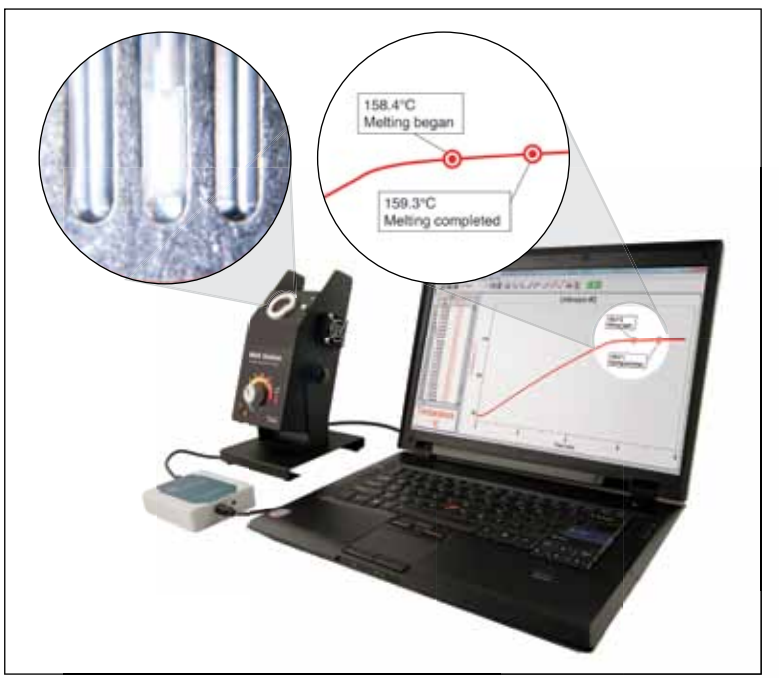
Melting Temperature Sensor

AVAILABLE MARCH 2011

Our new Melt Station connects to LabQuest, LabQuest Mini, Go!Link, or LabPro. It is used to measure the melting temperature of solid substances.

- Accurate results using built-in RTD over a range of 20°C to 260°C
- High-quality 6X viewing lens for clear observation of the samples
- Innovative, adjustable tilt allows for optimal viewing angle
- Cooling fan reduces time between tests

Each Melt Station comes with 100 standard capillary tubes. Additional packages of 100 are available,
ORDER CODE **MLT-TUBE**



Vernier Mini GC®

Use Room Air as a Carrier Gas

Our advanced MEMS GC chip technology allows you to use room air as a carrier gas. You also have the option of connecting other carrier gases to the Mini GC.

Connect to a Computer or LabQuest via USB

Vernier's Mini GC connects to both Windows and Macintosh computers via a robust USB connection. You can also connect directly to the Vernier LabQuest for real-time data acquisition.

Use Vernier's Award-Winning Software for Analysis

With either Vernier's Logger *Pro* for computers or Vernier's LabQuest App, peak integration analysis and retention-time determination are built right into the software.

What's Included:

- Vernier Mini GC
- Carrying case
- One high-quality Hamilton syringe
- Two spare septa
- Power supply
- USB cable
- 50+ page lab book
- User's guide

ORDER CODE
GC-MINI

Included Labs:

- Using a Gas Chromatograph: Identifying Unknown Compounds
- Verification of Esterification
- Quantifying Substances in a Mixture
- Fractional Distillation
- Investigating Gas Chromatography

Accessories:

GC Septa (pkg 4)
ORDER CODE **GC-SEP**

GC Syringe, 1 µL Hamilton
ORDER CODE **GC-SYR-MIC**

See training video at
www.vernier.com/videos

MORE ONLINE
For more information about the Mini GC, visit **www.vernier.com/gc**

Students analyzing ketones using the Vernier Mini GC and a LabQuest

Students analyzing ketones using the Vernier Mini GC and a computer running Logger Pro

Specifications

FAMILIES OF COMPOUNDS THAT CAN BE USED IN THE VERNIER MINI GC:

- Alcohols
- Aldehydes
- Aromatic hydrocarbons
- Carboxylic Acids
- Esters
- Ethers
- Ketones
- Nitriles

MEMS DETECTOR
The unique Seacoast Science MEMS Chemi-Capacitive Detector is state-of-the-art technology that allows air to be used as a carrier gas (three existing patents and one patent pending).

COLUMN
High-quality Restek MXT-1 stainless steel capillary column (11 meter)

TEMPERATURE REGULATION
Software-controlled temperature regulation from 30–120°C

COLUMN TEMPERATURE RAMP

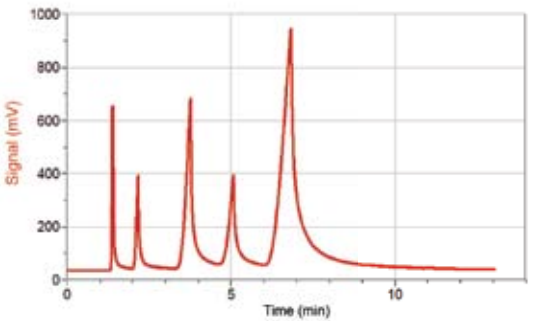
- Maximum of 10°C/minute
- Short warm-up time: <10 minute max for most labs

PRESSURE REGULATION
Software-controlled pressure regulation from 1–21 kPa above ambient

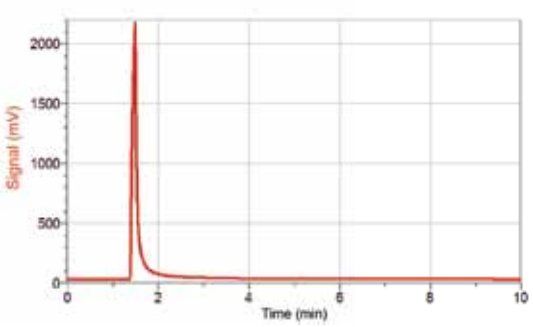
INJECTION

- Comes with one high-quality 1 µL Hamilton syringe
- Injection is direct from syringe to column
- 2 extra septa included with purchase (>150 injections/septa)
- Liquid injection volume: 0.01 to 0.50 µL

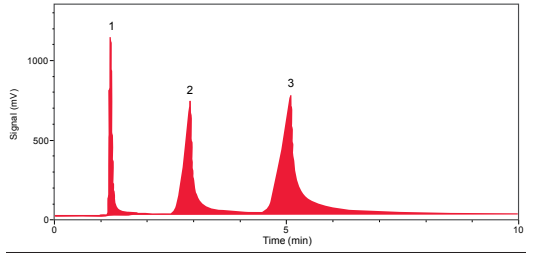
WARRANTY
Two-year warranty



Mini GC chromatogram of a ketone mixture

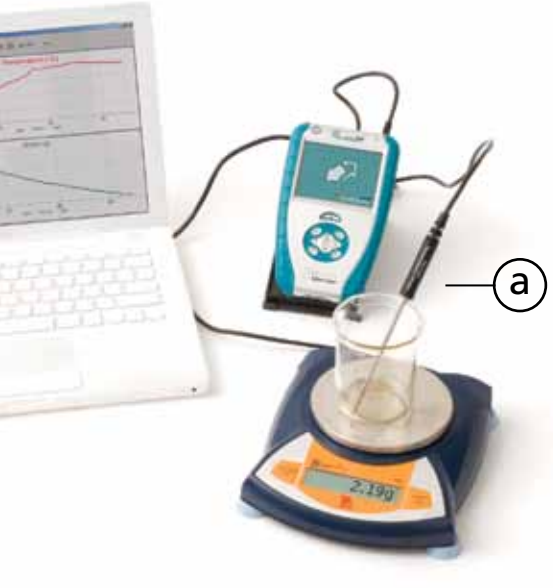


Mini GC chromatogram of acetone



Peak #	Compound	Retention Time (min)	Peak Area	% Area
1	acetone	1.207	83.6	16.1
2	4-methyl-2-pentanone	2.914	132.5	31.3
3	2-hexanone	5.077	273.6	52.6

Logger Pro *displays peak retention times and areas as a graph and as a table*



Real-Time Mass Measurements

a. Ohaus Scout™ Pro and Adventurer™ Pro* Balances

It is easy to collect mass data from an Ohaus Scout Pro or Adventurer Pro balance using our popular Logger *Pro* 3 software. Simply connect a Scout Pro or Adventurer Pro balance to your computer's USB or serial port (Scout Pro requires a connection kit and Adventurer Pro has a built-in USB connection), start the Logger *Pro* software, and you will be collecting real-time data as if the Ohaus balance was just another Vernier sensor!

Scout Pro 0.01 g balance (200 g) ORDER CODE **OHSP-202**
Scout Pro 0.01 g balance (400 g) ORDER CODE **OHSP-402**
Scout Pro 0.001 g balance (120 g) ORDER CODE **OHSP-123**

All three balances require:
Scout Pro USB connection kit ORDER CODE **OHSP-USB**

*Adventurer Pro balances are available at www.vernier.com/probes/ohaus.html

b. Instrumentation Amplifier, ORDER CODE INA-BTA

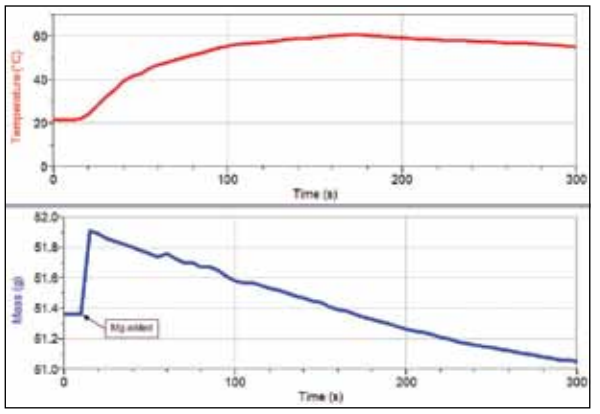
The Instrumentation Amplifier monitors voltages from 20 mV to 1 V (DC or AC). It has several switch settings to allow you to select the best gain. It is typically used to amplify the chart recorder or analog output of any instrument, such as a gas chromatograph.

c. Ion-Selective Electrodes

Great for monitoring four environmentally important ions: Nitrate (NO_3^-), Chloride (Cl^-), Calcium (Ca^{2+}), and Ammonium (NH_4^+). More on page 110.

Nitrate ISE **NO3-BTA**
Calcium ISE **CA-BTA**
Chloride ISE **CL-BTA**
Ammonium ISE **NH4-BTA**

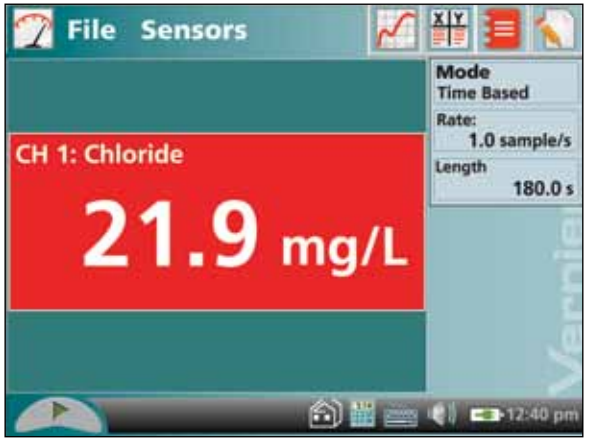
NOTE: Ion-Selective Electrodes require good chemical technique and careful calibration to obtain accurate results. They are not recommended for middle school or elementary school students.



Monitoring temperature and mass in the HCl-Mg reaction

Vernier & FLINN SOFTWARE & TECHNOLOGY

Since 1995, Vernier has partnered with Flinn Scientific, the leading provider of chemistry education products, to provide outstanding support for AP Chemistry lab activities. Vernier and Flinn have expanded their commitment to AP Chemistry by offering a series of 2-day AP Chemistry workshops (see page 125).



Testing the chloride ion concentration of pond water

Ocean Optics™ Spectrometers

	Vernier Spectrometer (Ocean Optics powered)	Ocean Optics Red Tide Spectrometer	Ocean Optics Red Tide UV-VIS Spectrometer
Wavelength Range and Resolution	• 380–950 nm • VIS-NIR • 2 nm between reported values • ~3 nm optical resolution	• 380–950 nm • VIS-NIR • 1 nm between reported values • ~2 nm optical resolution	• 200–850 nm • UV-VIS • 1 nm between reported values • ~2 nm optical resolution
Light Source & Sample Holder	Combination sample holder and LED-boosted tungsten source. The sample holder takes standard 1 cm cuvettes.	Combination sample holder and LED-boosted tungsten source. The sample holder takes standard 1 cm cuvettes.	Combination sample holder and integrated deuterium tungsten halogen light source. The sample holder takes standard 1 cm cuvettes.
Items Included*	• Spectrometer • Light source and cuvette holder • USB cable • 15 plastic cuvettes with lids • Connects by USB to a computer or LabQuest interface; no additional power source needed	• Spectrometer • Light source and cuvette holder • USB cable • 15 plastic cuvettes with lids • Connects by USB to a computer or LabQuest interface; no additional power source needed	• Spectrometer • Light source and cuvette holder • USB cable • 15 UV-VIS cuvettes with lids • Power supply • Connects by USB to a computer or LabQuest interface; no additional power source needed
Order Code	**V-SPEC***	**SPRT-VIS†***	**SPRT-UV-VIS***

† If you are going to use your Red Tide Spectrometer exclusively for emissions (and not for absorbance and percent transmittance measurements), you can purchase the Red Tide Emissions Spectrometer separately, for a lower price. See page 73 for details.
* Software needed: Logger *Pro* or LabQuest App

Spectrometer Accessories

Cuvettes

Plastic Cuvettes pkg of 100 (visible range)
ORDER CODE **CUV**
(Use with V-SPEC, SPRT-VIS, SVIS, and SVIS-PL)

Plastic UV Cuvettes pkg of 100 (UV-VIS)
ORDER CODE **CUV-UV**
(Use with SPRT-UV-VIS)

Cuvette Rack
ORDER CODE **CUV-RACK**

Optical Fiber

Connects easily to an Ocean Optics or Vernier Spectrometer, 2 m in length, and is used to conduct emission spectrum studies.

VIS-NIR Optical Fiber
ORDER CODE **VIS-NIR**
(Use with V-SPEC, SPRT-VIS, and ESRT-VIS)

UV-VIS Optical Fiber
ORDER CODE **UV-VIS**
(Use with SPRT-UV-VIS)

SpectroVis® Plus

An Affordable Spectrophotometer and Fluorometer

ORDER CODE
SVIS-PL

Having a CCD array spectrometer/fluorometer combination is now affordable for each of your lab stations! Array spectrometer technology allows you to collect a full wavelength spectrum (absorbance, percent transmittance, or intensity) in less than one second. Once the peak wavelength is determined, you can easily determine the concentration of a solution (Beer's law) or monitor rates of reaction.

What's New and Improved with SpectroVis Plus?

- Improved range: 380–950 nm (VIS-NIR)
- 1 nm between reported values (now collects 570 values)
- Improved optical resolution (~2.5 nm)
- New support for fluorescence (two excitation sources centered at 405 nm and 500 nm)

More Features

- Portable: 15 cm x 9 cm x 4 cm
- Collect a full spectrum in less than 1 second
- Easy one-step calibration
- Connects directly to LabQuest or to a computer's USB port
- No external power required
- Software required: Logger *Pro* 3.8.2 (or newer) or LabQuest App 1.4 (or newer)

Spectrum Tube Single Power Supply

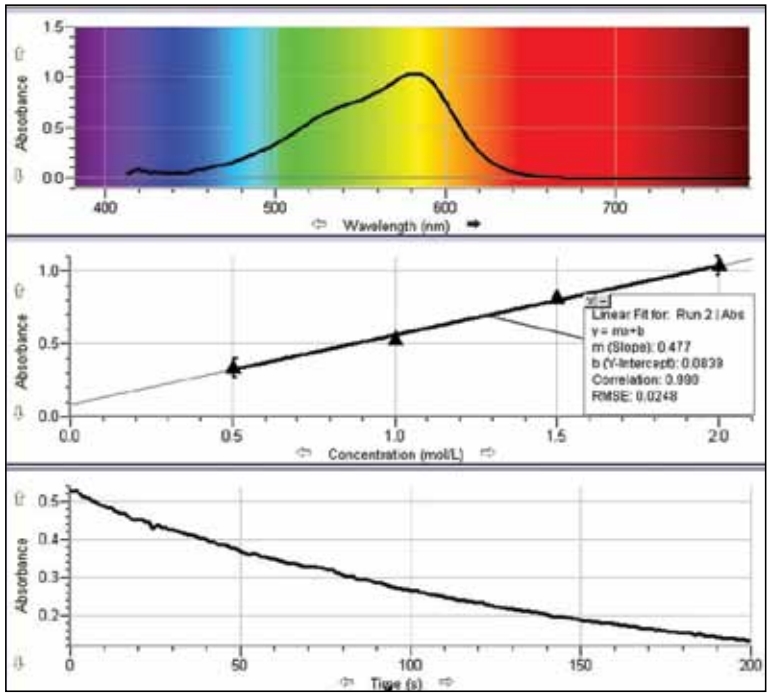
ORDER CODE **ST-SPS**

For more information see page 73.

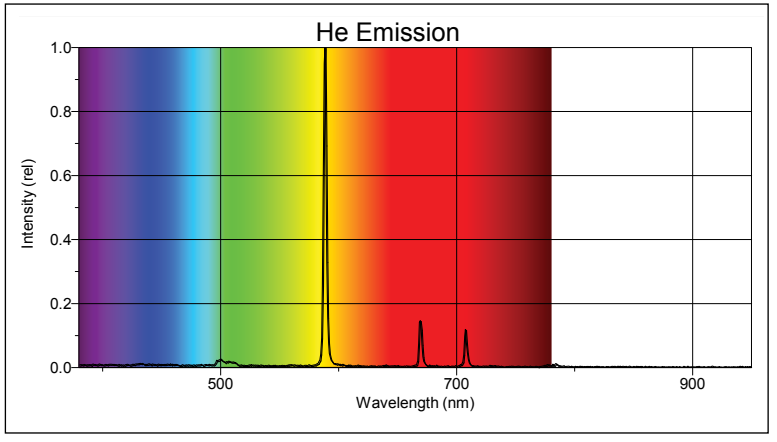
SpectroVis Optical Fiber

ORDER CODE **SVIS-FIBER**

Turn your SpectroVis Plus spectrophotometer into an emissions spectrometer using the SpectroVis Optical Fiber insert. Simply insert the unit into the cuvette holder and point the 1 m optical fiber at a light source. Use with SpectroVis and SpectroVis Plus.



Absorbance spectrum of crystal violet

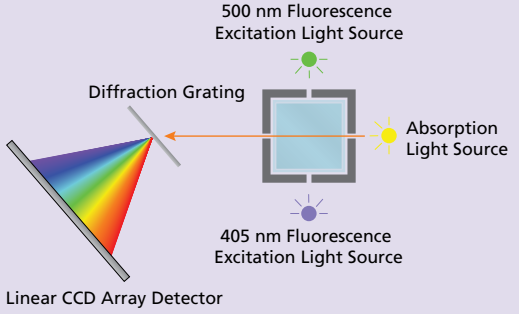


Helium emission spectrum

Uses

- Measure absorbance, percent transmittance, emissions spectra, or fluorescence
- Conduct Beer's law investigations
- Conduct kinetic studies of absorbance *vs.* time
- Perform equilibrium studies of absorbance *vs.* time or absorbance *vs.* concentration
- Conduct experiments on enzyme kinetics
- Perform colorimetric or fluorescent bioassays
- Measure emissions of gas discharge tubes, flame tests, or other light sources, using the SpectroVis Optical Fiber (not included)

How Does it Work?

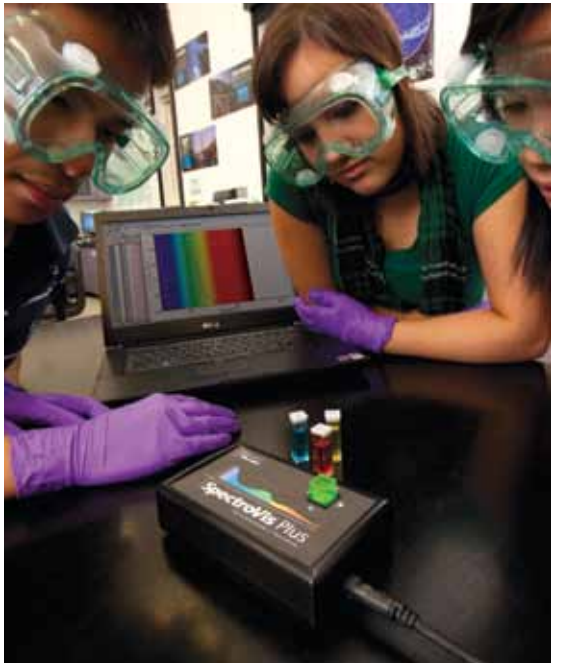


Light from our long-lived LED light source passes through a solution. Emerging light goes through a high-quality diffraction grating then the diffracted light is collected and sorted by the CCD array detector.

With its two different excitation wavelengths, SpectroVis Plus can quantitatively measure the fluorescence spectra of many compounds, such as quinine, fluorescein, and chlorophyll.

Free Spectrometer Labs

Introduce your students to the common use of a spectrometer including the classic Beer's law, emissions from discharge tubes, and a novel look at theatrical lighting filters. More at **www.vernier.com/spectroscopy**



1 IT ALL STARTS WITH CURRICULUM

Want to save time? Start with a Vernier lab book. Aligned to state and national science standards, our lab books contain experiments for LabQuest, computers, and TI graphing calculators.

2 CHOOSE YOUR INTERFACE

Vernier LabQuest – LabQuest is our color, touch-screen interface. Use it as a standalone device or as a computer interface. More details on pp. 5–11.

LabQuest Mini – LabQuest Mini is a low-cost computer solution with five sensor ports. More details on pp. 12–13.

Vernier LabPro – For data collection with TI graphing calculators, see details on pp. 92-93.

3 CHOOSE YOUR SENSORS

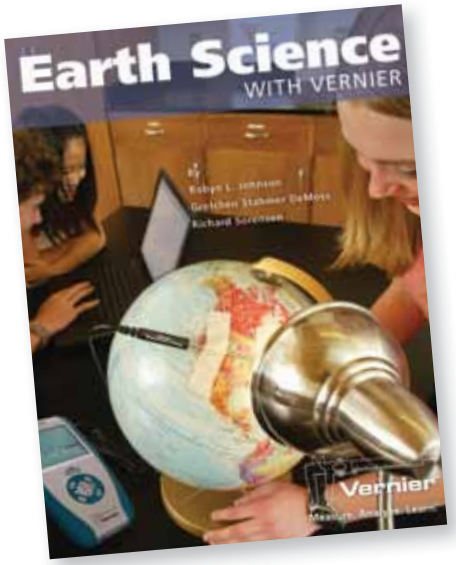
Choose from Vernier's recommended packages or build your own from our list of sensors.

Our Deluxe Package contains all the sensors needed to perform every experiment in our Earth science lab book.

Build custom packages online at www.vernier.com/guide

4 ADD A COPY OF LOGGER *PRO*

This award-winning software is the best value around! Includes a site license for all computers in your school or your college department, as well as students' personal computers. See pp. 16–19 for details.



GREAT VALUE

Purchase the Lab Book

ORDER CODE
ESV

Vernier lab books are loaded with teacher tips, sample graphs, and more. When you buy the lab book you will receive:

- Essential teacher information.
- 33 ready-to-use student versions of Logger *Pro* experiments on hard copy. LabQuest, computer, and calculator versions on CD.
- A generous site license. Buy one book and duplicate labs for your class.
- Easily edit labs to meet your personal teaching style using Microsoft® Word® files for all versions of the experiments on CD.
- Suggested answers, sample data, and graphs.
- Complete equipment and supplies list.

Features listed above are only available when you purchase the lab book. They are not available in the downloadable evaluation PDF.

***Earth Science with Vernier* lab book contains the following experiments:**

USING A TEMPERATURE PROBE
- Introduction to Data Collection
- Soil Temperature
- Water Quality — Temperature
- Freezing of Ocean Water
- Reflection and Absorption of Light
- The Greenhouse Effect
- Land and Sea Breezes
- Relative Humidity
- Dew Point
- Wind Chill
- Seasons and Angle of Insolation
- Fossil Fuels
- Solar Homes

USING A LIGHT SENSOR
- Reflection and Absorption of Light
- Photovoltaic Cells

USING A PH SENSOR
- Soil pH
- Soil and Acid Rain
- Water Quality — pH
- Water Treatment
- Acid Rain and Its Effect on Surface Water

USING A MOTION DETECTOR
- Mapping the Ocean Floor

USING A UVB SENSOR
- Are All Sunglasses Created Equal?
- Comparing Sunscreens
- UV Light and Clothing

USING A CONDUCTIVITY PROBE
- Soil Salinity
- Water Quality — Total Dissolved Solids
- Water Treatment
- Salinity of Ocean Water
- Desalination

USING A TURBIDITY SENSOR
- Water Quality — Turbidity
- Water Treatment

USING A MAGNETIC FIELD SENSOR
- Exploring Magnetism
- Where IS North?
- Searching for Iron Ore
- Sea Floor Spreading

USING CURRENT AND VOLTAGE PROBES
- Photovoltaic Cells
- Wind Power

STARTER PACKAGES DELUXE PACKAGES VIDEO ONLINE

Look for training videos of some of these labs at www.vernier.com/videos

Earth Science LabQuest and LabQuest Mini Packages

Purchase one package per lab group (2–4 students) OR BUILD YOUR OWN PACKAGE from the list of recommended sensors below.

Standalone or Computer

LabQuest Interface & Sensors	CODE	Starter Package LQ-ES-ST	Deluxe Package LQ-ES-DX
Vernier LabQuest Interface	LABQ	✔	✔
(2) Stainless Steel Temperature Probes	TMP-BTA	✔	✔
Light Sensor	LS-BTA	✔	✔
pH Sensor	PH-BTA	✔	✔
UVB Sensor	UVB-BTA	✔	✔
Magnetic Field Sensor	MG-BTA		✔
Conductivity Probe	CON-BTA		✔
Voltage Probe	VP-BTA		✔
Current Probe	DCP-BTA		✔
Turbidity Sensor	TRB-BTA		✔
Motion Detector	MD-BTD		✔

LABQUEST EARTH SCIENCE PACKAGE

You will also need:

***Earth Science with Vernier* lab book,** ORDER CODE **ESV**
See previous page.

Logger *Pro* 3 software, ORDER CODE **LP**
Buy just one copy—site license for ALL school and students' personal computers is included! See pp. 16–19 for details.

Computer Only

LabQuest Interface & Sensors	CODE	Starter Package LM-ES-ST	Deluxe Package LM-ES-DX
Vernier LabQuest Mini Interface	LQ-MINI	✔	✔
(2) Stainless Steel Temperature Probes	TMP-BTA	✔	✔
Light Sensor	LS-BTA	✔	✔
pH Sensor	PH-BTA	✔	✔
UVB Sensor	UVB-BTA	✔	✔
Magnetic Field Sensor	MG-BTA		✔
Conductivity Probe	CON-BTA		✔
Voltage Probe	VP-BTA		✔
Current Probe	DCP-BTA		✔
Turbidity Sensor	TRB-BTA		✔
Motion Detector	MD-BTD		✔

LABQUEST MINI EARTH SCIENCE PACKAGE

You will also need:

***Earth Science with Vernier* lab book,** ORDER CODE **ESV**
See previous page.

Logger *Pro* 3 software, ORDER CODE **LP**
Buy just one copy—site license for ALL school and students' personal computers is included! See pp. 16–19 for details.

FOR TI CALCULATOR-BASED DATA COLLECTION:
see pp. 94–100

LABPRO PACKAGES AND GO!LINK PACKAGES can be found at
www.vernier.com/pkgs

Davis Weather Stations

Because they are accurate, economical, easy to use, and well built, Davis Weather Stations are a perfect choice for your school. The Davis Vantage Vue™ weather station is rugged, accurate, reliable, and very affordable. If you want customizable, professional units, the Vantage Pro2 and Vantage Pro2 Plus are excellent choices. All versions are wireless.

For further information about Davis Weather Station products, including computer software and hardware mounting options, see **www.vernier.com/weather**

a. Vantage Vue™, ORDER CODE DWVUE

The Vantage Vue weather station includes a console with AC power adapter and a self contained, easy-to-install sensor system. The console displays current data along with the ability to view graphs. All without a computer!

The integrated sensor suite combines a rain collector, temperature sensor, humidity sensor, wind direction and anemometer—all in one package. Vantage Vue provides all of the following:

- Barometric pressure
- Rain rate
- Inside and outside humidity
- Rainfall totals
- Inside and outside temperature
- Wind chill
- Wind speed and direction
- Heat index
- Dew point
- Moon phase
- Local forecast
- Time of sunrise and sunset at your location
- Highs and lows for most weather variables

b. Vantage Pro2™, ORDER CODE DWVP

The Vantage Pro2 includes all of the features of Vantage Vue, however, you can add professional features such a fan-aspirated radiation shield and other sensors.

Vantage Pro2 Plus™, ORDER CODE DWPLUS

The Vantage Pro2 Plus includes all of the features of Vantage Pro2, plus a UV sensor, solar radiation sensor, and a sensor mounting shelf. With the Solar Radiation Sensor, you can also measure evapo-transpiration, solar radiation intensity, and THSW (temperature/humidity/sun/wind) index. The UV Sensor provides UV dose and UV index.

Davis Vantage Vue Console/Receiver

ORDER CODE **DWVUE-CR**

By purchasing additional Vantage Vue Console/Receivers, you can set up multiple monitoring stations in other classrooms throughout your school.

ESRI Technology CORPORATE ALLIANCE

Map Your Data Using GIS software from ESRI

Map your Vernier data with ArcGIS Explorer, the free virtual globe from ESRI. ArcGIS Explorer can be downloaded at **www.esri.com/arcgisexplorer**

Water quality along Beaverton Creek mapped in ArcGIS Explorer

NEW Anemometer

ORDER CODE **ANM-BTA**

The Vernier Anemometer is an impeller-type anemometer that measures wind speed in the range of 0.5 to 30 m/s (1 to 67 mph). The Anemometer fits in your palm for wind study measurements in the field. A standard camera mount on the back and an accessory rod allows you to position it in wind tunnels or in front of fans for wind turbine experiments.

Global Positioning Systems (GPS)

a. Vernier GPS Sensor

ORDER CODE **VGPS**

The Vernier GPS Sensor (Global Positioning System) collects location data such as latitude, longitude, and altitude right on your LabQuest or computer. This small, lightweight sensor connects directly to the USB port and works with LabQuest App and Logger *Pro* software. See a real-time graph of latitude *vs.* longitude, or export the data to various mapping programs such as Google Maps or ArcGIS.

With the GPS Sensor, LabQuest can record your location as you measure water quality at various sites along a stream, then map the data via Logger *Pro*.

Physics students can use a LabQuest and GPS Sensor to track location *vs.* sensor data, such as acceleration, in a car or train. Logger *Pro* can export a color-coded track for display to a map.

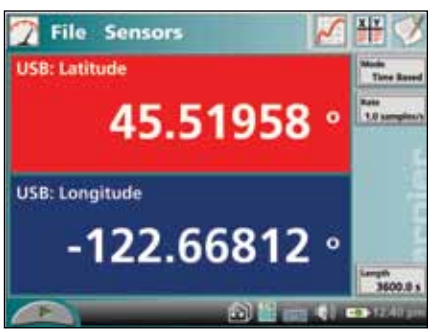
b. Garmin eTrex Venture HC

ORDER CODE **GAR-VENTHC**

The eTrex Venture HC features include:

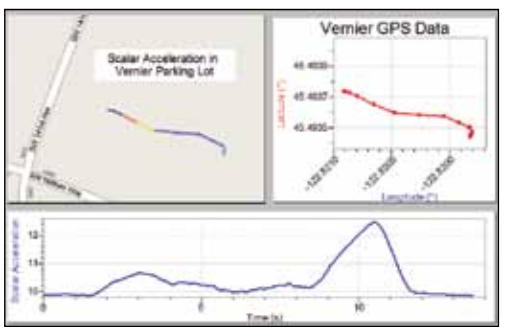
- A high-sensitivity GPS receiver for peak performance in any environment.
- Built-in basemap containing lakes, rivers, cities, interstates, national and state highways, railroads and coastlines.
- 256-color, sunlight-readable display makes it easy to distinguish map details—even in bright sunlight.
- Location data from the Garmin eTrex Venture HC can be transferred to Logger *Pro*.

MORE ONLINE
For a complete list of compatible GPS models, visit **www.vernier.com/gps**

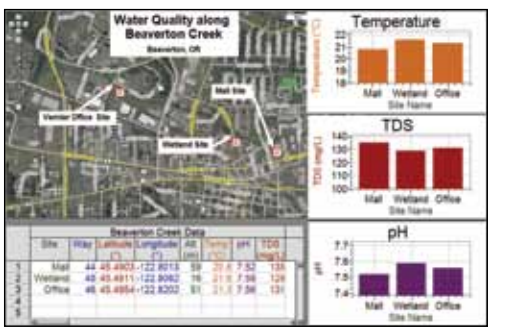


LabQuest showing latitude and longitude

LabQuest graphing the path of a bus ride in Tierra del Fuego



Visually mapping acceleration using Google Maps and Logger Pro



Logger Pro *combines GPS data and water quality sensor data*

1 IT ALL STARTS WITH CURRICULUM

Want to save time? Start with a Vernier lab book. The *STEM 2 with Vernier® and LEGO® MINDSTORMS® NXT* contains traditional science experiments, as well as design-and-build robotics projects.

2 ADD THE LEGO NXT INTERFACE & VERNIER NXT ADAPTER

Connect over 30 Vernier sensors to the LEGO NXT for science experiments and robotics projects. See page 50.

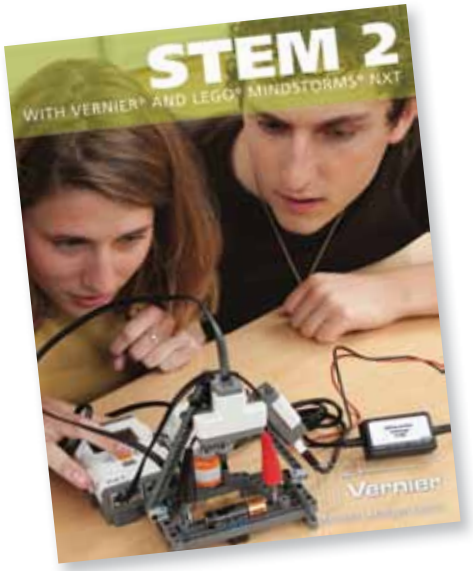
3 CHOOSE YOUR SENSORS

Choose from Vernier's recommended packages or build your own from our list of sensors.

Our STEM and STEM 2 Packages contain all the sensors needed to perform every experiment in each lab book.

4 CHOOSE YOUR SOFTWARE

The STEM lab book assumes you are using LEGO MINDSTORMS software. For advanced robotics projects, we recommend using National Instruments LabVIEW™ Education Edition software. You can find advanced example projects and sample movies at **www.vernier.com/nxt**



GREAT VALUE

Purchase the Lab Book

ORDER CODE
STEM2

Vernier lab books are loaded with teacher tips, sample graphs, and more. When you buy the lab book, you will receive

- Essential teacher information.
- 12 ready-to-use experiments.
- 8 design-and-build robotics projects.
- A generous site license. Buy one book and duplicate labs for your class.
- Microsoft® Word® files for all experiments on CD.
- A CD with MINDSTORMS sample programs, movie clips, and LEGO Digital Designer files.
- Suggested answers, sample data, and graphs.
- Complete equipment and supplies list.

Features listed above are only available when you purchase the lab book. They are not available in the downloadable evaluation PDF.

DOWNLOAD evaluation PDFs for all labs at **www.vernier.com/labs**

STEM 2 covers core topics in Physical Science

***STEM 2 with Vernier and LEGO MINDSTORMS NXT* lab book contains the following experiments and robotics projects:**

USING A DIFFERENTIAL VOLTAGE PROBE

EXPERIMENTS
- Batteries
- Lemon Battery
- Solar Cells

PROJECTS
- Battery Tester
- Solar Tracker

USING A DUAL-RANGE FORCE SENSOR

EXPERIMENTS
- Buoyancy
- First-Class Levers
- Friction
- Pulleys

PROJECTS
- Audio Assistant
- String Tension Tester

USING A GAS PRESSURE SENSOR

EXPERIMENTS
- Gas Pressure
- Grip Strength
- Yeast in Action

PROJECT
- Cartesian Diver

USING A MAGNETIC FIELD SENSOR

EXPERIMENTS
- Electromagnets
- Mapping a Magnetic Field

PROJECT
- Magnet Finder
- Migrating Robot
- Mine Sweeper

VIDEO ONLINE

Look for training videos of some of these labs at **www.vernier.com/videos**

Engineering LEGO NXT Packages

Purchase one package per lab group (2–4 students) OR BUILD YOUR OWN PACKAGE from the list of recommended sensors on page 50.

NXT SENSOR ADAPTER

NXT Sensor Adapter & Sensors	CODE	STEM 2 Physical Science Package NXT-PS	STEM Environmental Science Package NXT-EV
NXT Sensor Adapter	BTA-NXT	✔	✔
Magnetic Field Sensor	MG-BTA	✔	
Differential Voltage Probe	DVP-BTA	✔	
Dual-Range Force Sensor	DFS-BTA	✔	
Gas Pressure Sensor	GPS-BTA	✔	
Stainless Steel Temperature Probe	TMP-BTA		✔
pH Sensor	PH-BTA		✔
UVB Sensor	UVB-BTA		✔
Conductivity Probe	CON-BTA		✔
Soil Moisture Sensor	SMS-BTA		✔

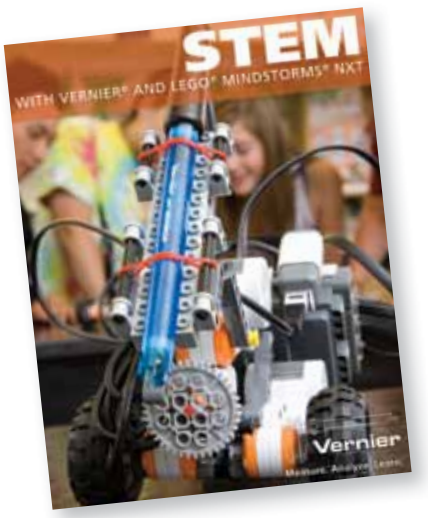
You will also need:

one or both of our STEM with Vernier books.

See below. ORDER CODE **STEM**

See previous page. ORDER CODE **STEM2**

NXT SENSOR ADAPTER | ENGINEERING **STEM 2** PACKAGE | ENGINEERING **STEM** PACKAGE



STEM covers core topics in Environmental Science

ORDER CODE **STEM**

***STEM with Vernier and LEGO MINDSTORMS NXT* lab book contains the following experiments and robotics projects:**

☐ **USING A pH SENSOR**

EXPERIMENTS
- Household Acids and Bases
- Acid Rain
- Soil pH and Water Absorption
- Water Quality
- A Water Field Study

PROJECTS
- Acidity Tester
- Aquarium Monitor

☐ **USING A UVB SENSOR**

EXPERIMENTS
- UV Light and Clothing
- UV Light and Sunglasses
- Comparing Sunscreens

PROJECT
- Sunscreen Tester

☐ **USING A TEMPERATURE PROBE**

EXPERIMENTS
- Heating of Land and Water
- Water Quality
- A Water Field Study
- A Good Sock

PROJECT
- Aquarium Monitor

☐ **USING A CONDUCTIVITY PROBE**

EXPERIMENTS
- Water Quality
- A Water Field Study
- Water Hardness
- Ocean Water

☐ **USING A SOIL MOISTURE SENSOR**

EXPERIMENTS
- Soil Moisture
- Managing Garden Soil Moisture

PROJECT
- Plant Waterer

VIDEO ONLINE

Look for training videos of some of these labs at www.vernier.com/videos

Robotics Videos

Cartesian Diver

This is a robot controlled version of the classic science demonstration. A LEGO pneumatic pump and a valve are controlled by the robot to adjust pressure. The Vernier Gas Pressure Sensor is used to monitor the pressure.

Audio Assistant

This project challenges the students to write a program to indicate the Dual-Range Force Sensor reading with a sound, rather than a number or a graph. The frequency of the sound produced by the NXT is related to the force.

Solar Tracker

The NXT monitors the output from two solar panels using the Vernier Differential Voltage Probe. The solar panels are mounted on a rotating platform. The robot rotates the platform toward the solar panel with the most light. The net result is that the solar panels follow the sun.

Migrating Robot

This robot uses a Vernier Magnetic Field Sensor to detect the Earth's magnetic field and find north. It then migrates north, much like many animals do in the spring.

Many other robotics videos available at **www.vernier.com/nxt/projects.html**

SENSORS COMPATIBLE WITH NXT SENSOR ADAPTER

SENSOR	CODE	SENSOR	CODE	SENSOR	CODE
Accelerometers		Flow Rate Sensor	FLO-BTA	Soil Moisture Sensor	SMS-BTA
25-g Accelerometer	ACC-BTA	Force Plate	FP-BTA	Sound Level Meter	SLM-BTA
Low-g Accelerometer	LGA-BTA	Gas Pressure Sensor	GPS-BTA	Temperature Sensors	
Barometer	BAR-BTA	Hand Dynamometer	HD-BTA	Stainless Steel Temperature Probe	TMP-BTA
Charge Sensor	CRG-BTA	Instrumentation Amplifier	INA-BTA	Extra-Long Temperature Probe	TPL-BTA
Colorimeter	COL-BTA	Light Sensor	LS-BTA	Surface Temperature Sensor	STS-BTA
Conductivity Probe	CON-BTA	Magnetic Field Sensor	MG-BTA	Thermocouple	TCA-BTA
Current Probe	DCP-BTA	O_2 Gas Sensor	O2-BTA	Turbidity Sensor	TRB-BTA
Differential Voltage Probe	DVP-BTA	ORP Sensor	ORP-BTA	UVA Sensor	UVA-BTA
Dissolved Oxygen Probe	DO-BTA	pH Sensor	PH-BTA	UVB Sensor	UVB-BTA
Dual-Range Force Sensor	DFS-BTA	Relative Humidity Sensor	RH-BTA		
Electrode Amplifier	EA-BTA	Salinity Sensor	SAL-BTA		

Enhance LEGO NXT Robotics

The NXT Sensor Adapter

ORDER CODE
BTA-NXT

- Connect over 30 Vernier sensors to the NXT Intelligent Brick (see above)
- Create sensor-based control systems
- Use with LEGO MINDSTORMS NXT, NI LabVIEW, or ROBOLAB
- View movies and download FREE project ideas at **www.vernier.com/nxt**

The DCU used with a LabPro, Conductivity Probe, and Temperature Probe to automate tea brewing

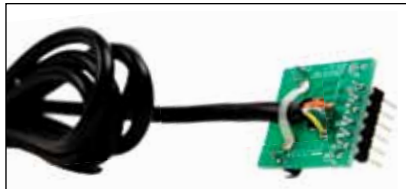
ORDER CODE
DCU-BTD

The Digital Control Unit (DCU) gives you an easy way to use SensorDAQ, LabQuest, LabQuest Mini, or LabPro digital ports for exciting, do-it-yourself projects. It provides useful current (up to 600 mA) for controlling electrical devices.

Power supply not included
(ORDER CODE IPS)

DCU Project Ideas:

- Temperature-controlled environment
- Flash lamps or LEDs
- Stepper motor control systems
- Alarm systems and feedback
- Moving displays
- Robots with sensors
- Electromagnetic mass driver



ORDER CODE
BB-BTA

Breadboard Cable

Want to Build Your Own Sensors?

Our Breadboard Cable:

- Provides an easy way for students to build their own sensor circuitry and input the signal into a Vernier interface for data acquisition.
- One end of the cable is a standard British Telecom Analog (BTA) connector that plugs into Vernier interfaces.
- The other end of the cable is a prototyping board connector that exposes the six sensor lines.

a. Power Amplifier

ORDER CODE **PAMP**

The Vernier Power Amplifier allows you to control output circuits with SensorDAQ and other Vernier lab interfaces. You can drive loads with ±10 V and currents up to 1 A. It has a built-in current sensor, so you can monitor the current output at the same time you control the voltage. Engineering projects with feedback loops, motor speed control, PID control, and many others are naturals with this hardware. See page 114 for more details on this device.

b. Instrumentation Amplifier

ORDER CODE **INA-BTA**

The Vernier Instrumentation Amplifier provides an easy means to connect circuits and devices that produce small voltage signals. A strain gage bridge circuit is an example. The signal from the strain gage circuit varies over a few millivolts and the Instrumentation Amplifier steps up this voltage into the range where it can be handled by SensorDAQ and other Vernier interfaces. The Instrumentation Amplifier has 6 input ranges. See page 109 for more details on this sensor.

c. Rotary Motion Sensor

ORDER CODE **RMV-BTD**

The Rotary Motion Sensor is a digital sensor that lets you monitor angles or study angular motion. It can be used to study linear motion by either rolling it along a surface or by connecting the object moving to it with a string. It works great for measurements of tilt angle, joint angle, motor speed, motor efficiency, or the motion of a physical pendulum. Create a low-cost PID trainer using a DC motor with a propeller to lift a metal rod connected to the Rotary Motion Sensor. Study PID variables as you attempt to move the rod to a desired angle without overshooting. See page 115 for more details on this sensor.

a. EKG Sensor, ORDER CODE EKG-BTA

The EKG sensor is a biopotential sensor that can be used to record EKGs from the heart and surface EMGs from muscle. Analyze the electrical activity of the heart, compare the activity of muscles, or investigate reflex activity. See page 107 for more details on this sensor.

b. Hand Dynamometer

ORDER CODE HD-BTA

The strain-gage based isometric dynamometer can be used to measure grip strength, pinch strength, and perform muscle fatigue studies. Combine the dynamometer with a Vernier EKG sensor (used to measure EMG) to measure maximum grip strength and correlate this with electrical activity of the muscles involved. See page 109 for more details on this sensor.

c. Spirometer, ORDER CODE SPR-BTA

Our Spirometer can be used to perform a variety of tests related to air flow and lung volume. The sensor includes a removable flow head (22 mm ID/30 mm OD) for easy cleaning and sterilization and a differential pressure transducer. The Spirometer is designed to make human respiratory measurements at rest and during moderate activity. See page 117 for more details.

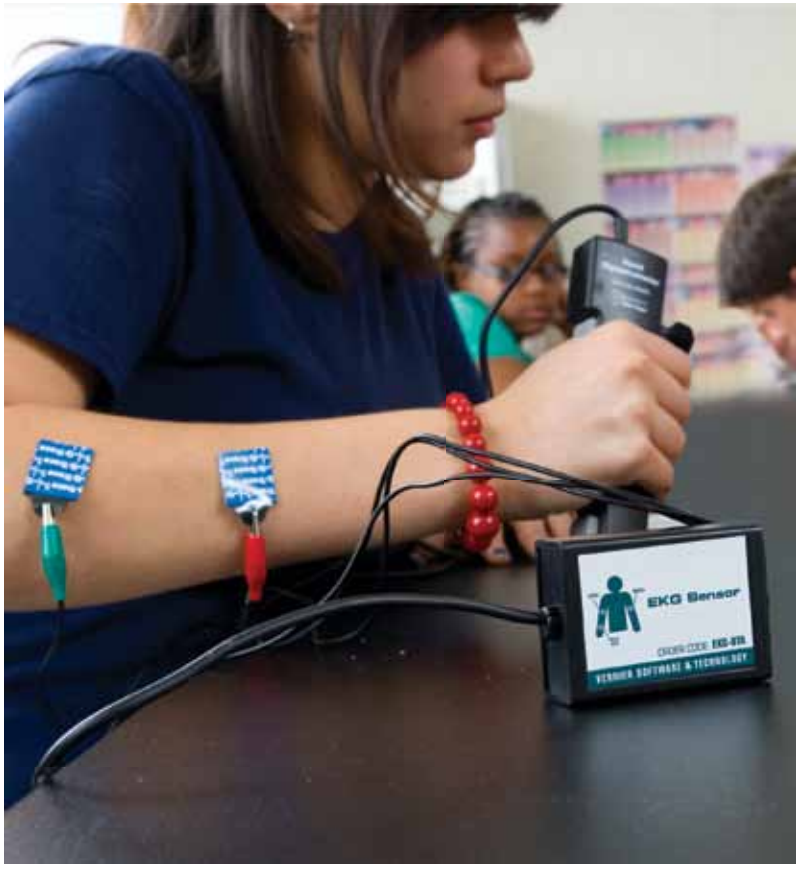
d. O_2 Gas Sensor, ORDER CODE O2-BTA

The O_2 Gas Sensor measures oxygen concentration in air. Use this sensor to analyze breathing patterns, or combine with a Vernier Spirometer to measure tidal volumes and oxygen concentrations of deeply inhaled and exhaled air. See page 112 for more details of this sensor.

e. Other Vernier Biomedical Sensors:

- **Blood Pressure Sensor**
- **Hand-Grip Heart Rate Monitor**
- **CO_2 Gas Sensor**
- **Surface Temperature Probe**

See pp. 80–81 for additional physiology sensors appropriate for biomedical engineering.



PROJECT LEAD THE WAY PLTW

Biomedical Sciences™ Program from Project Lead The Way

Project Lead The Way is a national organization that works with schools to implement rigorous hands-on, project-based engineering and engineering technology programs. They provide educators with the training and course materials needed to prepare students to be successful in these pursuits. For more information on PLTW, go to **www.pltw.org**

We have worked with PLTW to integrate our physiology sensors into their Biomedical Sciences courseware.

National Instruments LabVIEW™ Education Edition

Graphical Programming Language for High School STEM Education

The new National Instruments LabVIEW Education Edition software helps teachers bring STEM concepts to life through hands-on learning. This industry-standard NI LabVIEW (used throughout the engineering disciplines) includes modules for educational hardware, including these Vernier products:

- Go! Devices (Go!Link, Go!Temp, Go!Motion)
- NXT Sensor Adapter
- SensorDAQ

Full integration means that everything required for these Vernier products is included. Install NI LabVIEW Education Edition, connect the Vernier hardware, and begin running examples to:

- Log and analyze data
- Introduce engineering measurement and automation concepts
- Build sensor-controlled NXT robots
- Perform feedback and control
- Introduce biomedical concepts with physiology sensors

Single-User NI LabVIEW Education Edition, ORDER CODE **LVEE-1**
25-User NI LabVIEW Education Edition, ORDER CODE **LVEE-25**
Go to **www.vernier.com/labview** for more information

License available to U.S. high schools only. NI LabVIEW for use outside the U.S., in colleges and universities, or for individual use, should be purchased from National Instruments at **ni.com/academic**

Vernier LabVIEW Downloads

To download LabVIEW examples for the interfaces below, go to **www.vernier.com/labview/downloads/**

Go! devices

Mini GC

WDSS

NI ELVIS

LabPro

SensorDAQ

NXT Sensor Adaptor

LabQuest Mini

LabQuest

Screw Terminal
Build circuits, control motors, create custom sensors, and more
- 2 analog input
- 4 digital I/O
- 1 analog output
- 1 counter/pulse generator

3 Analog Sensor Channels
Connect any Vernier analog sensor

1 Digital Sensor Channel
Connect any Vernier digital sensor

Fast Sampling Rate
Up to 48,000 samples per second

SensorDAQ—Designed by NI & Vernier for Engineering Education

Perfect for teaching NI LabVIEW or for building sensor-control student projects using NI LabVIEW software

SensorDAQ, a joint project of National Instruments and Vernier, is a USB data-acquisition interface that offers convenience and power to engineering students.

- Connect over 55 Vernier sensors
- Compatible with any Vernier analog or digital sensor. Go to **www.vernier.com/sensordaq**
- Use with NI LabVIEW software version 8.2 or newer (not included)

Not compatible with Logger Pro *or Logger Lite software*

ORDER CODE
SDAQ

Includes: SensorDAQ, Voltage Probe, USB cable, User's Manual, and sample programs

1 IT ALL STARTS WITH CURRICULUM

Want to save time? Start with a Vernier lab book. Learn how to program with NI LabVIEW with our *Hands-On Introduction to NI LabVIEW* book. Then, take your LabVIEW programming to the next level with the NEW *Engineering Projects with NI LabVIEW and Vernier* book.

2 CHOOSE YOUR INTERFACE

We recommend the SensorDAQ as our Engineering interface to use with NI LabVIEW software.

LabQuest and LabQuest Mini can also be programmed with NI LabVIEW and are supported by the Engineering lab books.

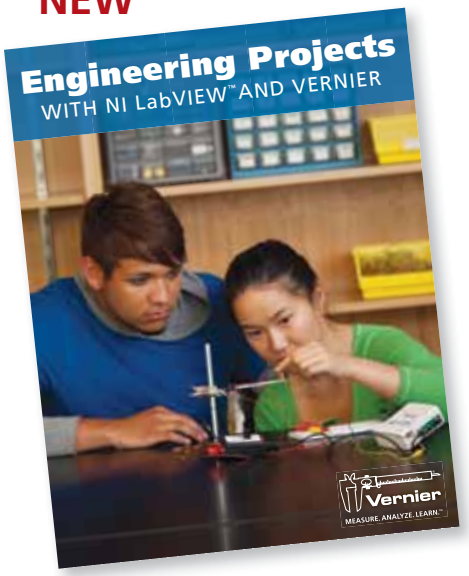
3 CHOOSE YOUR SENSORS

Choose from Vernier's recommended packages or build your own from our list of sensors.

4 ADD A COPY OF NI LABVIEW

We recommend NI LabVIEW Education Edition, which introduces students to a powerful engineering software. See page 53 for details.

NEW



GREAT VALUE

Purchase the Lab Book

ORDER CODE
EPV

This new lab book contains engaging hands-on projects for SensorDAQ, LabQuest, or LabQuest Mini. It introduces engineering concepts and programming with NI LabVIEW development software. An introductory knowledge of NI LabVIEW programming (see our *Hands-On Introduction to NI LabVIEW* book) is assumed. When you buy the lab book you will receive:

- Essential teacher information
- 12 projects with challenge exercises
- A generous site license. Buy one book and duplicate labs for your class.
- Microsoft® Word® files for all experiments and teacher files on CD. Easily modify these files to meet your personal teaching style.
- NI LabVIEW sample programs on CD for each project and challenge.

Features listed above are only available when you purchase the lab book. They are not available in the downloadable evaluation PDF.

DOWNLOAD evaluation PDFs for all labs at **www.vernier.com/labs**

***Engineering Projects with NI LabVIEW and Vernier* contains the following projects:**

- ☐ ☐ **Build a Temperature Sensor**
- ☐ ☐ **Digital Control Systems**
- ☐ ☐ **3-Color LED**
- ☐ ☐ **Hot Wire Anemometer**
- ☐ ☐ **DC Motor Control**
- ☐ ☐ **Light Intensity**
- ☐ ☐ **Servo Motor***
- ☐ ☐ **EKG**
- ☐ ☐ **Blood Pressure**
- ☐ ☐ **Strain Gage Measurement**
- ☐ ☐ **Propeller Control**
- ☐ ☐ **Ping-Pong Ball Levitation***

☐ STARTER PACKAGES ☐ DELUXE PACKAGES ▶ VIDEO ONLINE

* Project can be done only with the SensorDAQ

A Great Way to Teach STEM

This book introduces many important science and engineering concepts, including analog and digital input, sensors and how they are calibrated, feedback and control, analog and digital output, servo and stepper motors, PID control, pulse-width modulation, voltage dividers and Wheatstone bridges.

Videos of many of these projects are available at **www.vernier.com/epv**

Engineering NI LabVIEW Packages

Purchase one package per lab group (2–4 students).

SensorDAQ

Packages are also available with LabQuest and LabQuest Mini. See www.vernier.com/engpkg

SensorDAQ and Sensors	CODE	Intro to NI LabVIEW Package SD-EE	Engineering Projects with NI LabVIEW Starter SD-EP-ST	Engineering Projects with NI LabVIEW Deluxe SD-EP-DX
SensorDAQ	SDAQ	✔	✔	✔
Microphone	MCA-BTA	✔		
Stainless Steel Temperature Probe	TMP-BTA	✔		
Surface Temperature Sensor	STS-BTA		✔	✔
Digital Control Unit	DCU-BTA		✔	✔
Breadboard Cable	BB-BTA		✔	✔
Instrumentation Amplifier	INA-BTA		✔	✔
Light Sensor	LS-BTA		✔	✔
EKG Sensor	EKG-BTA		✔	✔
Analog Proto Board Connector	BTA-ELV			✔
Digital Proto Board Connector	BTD-ELV			✔
Power Amplifier	PAMP			✔
Blood Pressure Sensor	BPS-BTA			✔
Motion Detector	MD-BTD			✔
Rotary Motion Sensor	RMV-BTD			✔
Photogate	VPG-BTD			✔

SENSORDAQ | ENGINEERING **NI LABVIEW** PACKAGE | ENGINEERING PROJECTS WITH **NI LABVIEW** PACKAGES

You will also need:

LabVIEW Education Edition Software (one per seat)

ORDER CODE **LVEE-1** (single user), or
ORDER CODE **LVEE-25** (25 users)

One or both Engineering lab books:
Hands-On Introduction to NI LabVIEW™ with Vernier ORDER CODE **LWV**
Engineering Projects with NI LabVIEW™ and Vernier ORDER CODE **EPV**

Hands-On Introduction to NI LabVIEW with Vernier

ORDER CODE **LWV**

This book introduces NI LabVIEW programming through a series of hands-on exercises using Vernier sensors and SensorDAQ or LabQuest or LabQuest Mini. All of these chapters can be completed with the SD-EE package. Contents include:

Getting Started
- Exercise 1 – Open and Run a SensorDAQ Example VI

NI LabVIEW Environment
- Exercise 2 – Read Microphone Data

NI LabVIEW Programming
- Exercise 3 – Read and Analyze Microphone Data

Working with Loops
- Exercise 4 – Continuous Read and Analyze Microphone Data

Presenting Results
- Exercise 5 – Read Temperature Data

Decision Making
- Exercise 6 – Above Threshold Warning of Temperature Data

SubVIs
- Exercise 7 – Create a Temperature Conversion SubVI

SensorDAQ Automation
- Exercise 8 – Control Analog Out, Digital Out, and Pulse Out

Project
- Exercise 9 – Build a Sensor Control Program

1 IT ALL STARTS WITH CURRICULUM

Looking to introduce inquiry into your curriculum? Start with a Vernier lab book. Aligned to state and national science standards, our lab book contains environmental science inquiry investigations.

2 CHOOSE YOUR INTERFACE

Vernier LabQuest – LabQuest is our color, touch-screen interface. Use it as a standalone device or as a computer interface. More details on pp. 5–11.

LabQuest Mini – LabQuest Mini is a low-cost computer solution with five sensor ports. More details on pp. 12–13.

3 CHOOSE YOUR SENSORS

Choose from Vernier's recommended packages or build your own from our list of sensors.

Our Deluxe Package contains all the sensors needed to perform every experiment in our environmental science lab book.

Build custom packages online at www.vernier.com/guide

4 ADD A COPY OF LOGGER *PRO*

This award-winning software is the best value around! Includes a site license for all computers in your school or your college department, as well as students' personal computers. See pp. 16–19 for details.

GREAT VALUE

Purchase the Lab Book

ORDER CODE
ESI

Vernier lab books are loaded with teacher tips, sample graphs, and more. When you buy the lab book you will receive:

- 34 inquiry-based, environmental science investigations.
- Essential teacher information for successful inquiry investigations.
- Suggested researchable questions, sample data, and graphs.
- A generous site-license. Buy one book and duplicate labs for your class.
- Microsoft® Word® files on CD for the experiments so you can easily edit labs to meet your personal teaching style.

Features listed above are only available when you purchase the lab book. They are not available in the downloadable evaluation PDF.

DOWNLOAD evaluation PDFs for all labs at www.vernier.com/labs

Investigating Environmental Science through Inquiry lab book contains the following inquiry experiments:

USING A TEMPERATURE PROBE
- Seasons and Angle of Insolation
- A Local Weather Study
- Water Quality
- Long Term Water Monitoring
- Soil Temperature
- Biodiversity in Ecosystems
- Water Cycle Column Investigations
- Decomposition Column Investigations
- Ecocolumn Investigations
- Global Warming
- Insulation Study
- Fossil Fuel Energy
- Energy Conversion
- An Investigation of Passive Solar Heating
- A Pollution Study

USING A TURBIDITY SENSOR
- Water Quality
- Long Term Water Monitoring
- Water Treatment
- Population Dynamics
- A Pollution Study

USING A pH SENSOR
- Water Quality
- Long Term Water Monitoring
- Water Treatment
- Soil pH
- Soil and Acid Precipitation
- Water Cycle Column Investigations
- Decomposition Column Investigations
- The Effect of Acid Deposition on Aquatic Ecosystems
- A Pollution Study
- Ecocolumn Investigations

USING A CONDUCTIVITY SENSOR
- Water Quality
- Long Term Water Monitoring
- Water Treatment
- Investigating Salinity
- Soil Salinity
- Water Cycle Column Investigations
- Ecocolumn Investigations
- The Effect of Acid Deposition on Aquatic Ecosystems

USING A SOIL MOISTURE SENSOR
- Soil Moisture
- Managing Garden Soil Moisture
- Biodiversity in Ecosystems
- Water Cycle Column Investigations
- Ecocolumn Investigations
- A Pollution Study

USING A DISSOLVED OXYGEN PROBE
- Investigating Dissolved Oxygen
- Water Quality
- Long Term Water Monitoring
- Biochemical Oxygen Demand
- Primary Productivity
- A Pollution Study

USING A UV SENSOR
- A Local Weather Study
- UV Investigations
- Comparing Sunscreens

USING A VOLTAGE & CURRENT PROBE
- Wind Power
- Photovoltaic Cells

USING A RELATIVE HUMIDITY SENSOR
- A Local Weather Study
- Biodiversity in Ecosystems
- Water Cycle Column Investigations
- Decomposition Column Investigations
- Ecocolumn Investigations
- A Pollution Study

USING A LIGHT SENSOR
- Biodiversity in Ecosystems
- Water Cycle Column Investigations
- Decomposition Column Investigations
- Ecocolumn Investigations
- Measuring Particulates
- Energy Conversions

USING A CO_2 GAS SENSOR
- Cell Respiration
- Water Cycle Column Investigations
- Decomposition Column Investigations
- Investigating Indoor Carbon Dioxide Concentrations
- A Pollution Study
- Ecocolumn Investigations

STARTER PACKAGES | DELUXE PACKAGES | VIDEO ONLINE

Environmental Science LabQuest Packages

Purchase one package per lab group (2–4 students) OR BUILD YOUR OWN PACKAGE from the list of recommended sensors below.

Standalone or Computer

LabQuest Interface & Sensors	CODE	Starter Package LQ-ENV-ST	Deluxe Package LQ-ENV-DX
Vernier LabQuest Interface	LABQ	✔	✔
Stainless Steel Temperature Probe	TMP-BTA	✔	✔
pH Sensor	PH-BTA	✔	✔
Conductivity Probe	CON-BTA	✔	✔
Dissolved Oxygen Probe	DO-BTA	✔	✔
Soil Moisture Sensor	SMS-BTA	✔	✔
Turbidity Sensor	TRB-BTA	✔	✔
Relative Humidity Sensor	RH-BTA		✔
UVB Sensor	UVB-BTA		✔
CO_2 Gas Sensor	CO2-BTA		✔
Voltage Probe	VP-BTA		✔
Current Probe	DCP-BTA		✔
Light Sensor	LS-BTA		✔

LABQUEST **ENVIRONMENTAL SCIENCE** LABQUEST

You will also need:

Investigating Environmental Science through Inquiry **lab book,** ORDER CODE **ESI** See previous page.

Logger *Pro* 3 software, ORDER CODE **LP**
Buy just one copy—site license for ALL school and students' personal computers is included! See pp. 16–19 for details.

More Environmental Science Packages can be found at www.vernier.com/pkgs

Vernier GPS Sensor

ORDER CODE
VGPS

The Vernier GPS (Global Positioning System) Sensor collects location data such as latitude, longitude, and altitude right on your LabQuest or computer.

- Record your location as you measure water quality at various sites along a stream.
- Track location *vs.* sensor data

See page 108 for more information.

See also *Water Quality with Vernier* lab book on page 84.

AP*/IB† Environmental Science

It is recommended that the AP Environmental Studies program and the IB Environmental Systems and Societies program include a strong laboratory and field investigation component. The *Investigating Environmental Science through Inquiry* lab book includes experiments correlated to both AP and IB standards. Environmental topics include:

- Earth Systems and Resources—Air and Water
- Earth Systems and Resources—Soil
- The Living World
- Energy Resources and Consumption
- Pollution

MORE ONLINE
For correlations of Vernier labs to AP/IB objectives, visit www.vernier.com/resources/ibes.html

* AP and Advanced Placement Program are registered trademarks of the College Entrance Examination Board, which was not involved in the production of and does not endorse this product.

† The IB Diploma Program is an official program of the International Baccalaureate Organization (IBO) which authorizes schools to offer it. The material available here has been developed independently of the IBO and is not endorsed by it.

Did you know?

All IB Group 4 experimental science courses now require students to use sensors for data logging in an experiment and software for graph plotting.

a. NEW LabQuest Battery Boost

ORDER CODE **LQ-BOOST**

The Battery Boost is a rechargeable external battery for your LabQuest. With the added power of an external battery, data can be collected for extended periods in the field where AC power is not available.

b. NEW Anemometer

ORDER CODE **ANM-BTA**

The Vernier Anemometer is an impeller-type anemometer that measures wind speed in the range of 0.5 to 30 m/s (1 to 67 mph). The Anemometer fits in your palm for wind study measurements in the field. A standard camera mount on the back and an accessory rod allows you to position it in wind tunnels or in front of fans for wind turbine experiments.

c. Soil Moisture Sensor

ORDER CODE **SMS-BTA**

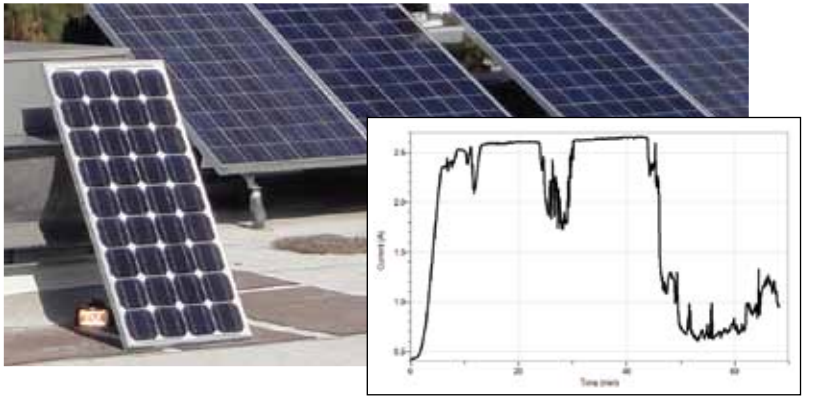
Uses capacitance to measure the water content of soil. Simply insert this rugged sensor in the soil to be tested and the volumetric water content of soil is reported in percent. Use it to conduct experiments in ecology, environmental science, agricultural science, horticulture, biology, and more.

d. Dissolved Oxygen Probe

ORDER CODE **DO-BTA**

This popular sensor is used to determine the concentration of oxygen in aqueous solutions. More on page 106.

- Built-in temperature compensation and a fast response time.
- Includes a zero-oxygen solution, two caps fitted with membranes, a 100% calibration bottle, and electrode filling solution.



Current from a solar panel

NEW High Current Sensor

Do you do experiments with solar panels or other high-current devices? We've often been asked to offer a current sensor that can handle the higher currents from hand-crank generators, large batteries, and solar panels—and now we have one!

The new Vernier High Current Sensor has a range of ±10 A. Current is measured with a Hall effect sensor, which uses the magnetic field created by the current. That means that no sense resistor is required, reducing the effect of the sensor on your circuit. A magnetic shield keeps measurements undisturbed by external fields. There's a user-replaceable fuse inside to protect the sensor.

The graph shows the current from a solar panel, which requires the wider range of the High Current Sensor.

For currents below 600 mA, the original Current Sensor (DCP-BTA) is still available and is the better choice for low-current experiments.

NEW 30-Volt Voltage Probe

We also have a new 30-Volt Voltage Probe that's great for using with large solar panels.

ORDER CODE
HCS-BTA

ORDER CODE
30V-BTA

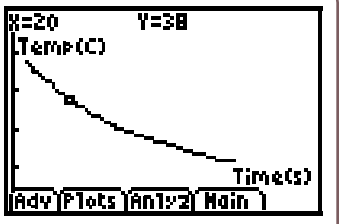
MATH

VERNIER EasyTemp®

ORDER CODE **EZ-TMP**

- Simplifies temperature data collection
- Plugs directly into your TI-84 Plus calculator or TI-Nspire handheld

More on page 99



$y = a \cdot b^x + c$

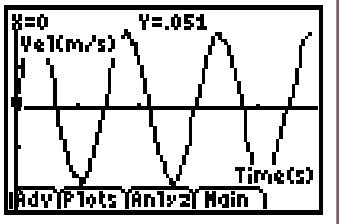
Exponential

TEXAS INSTRUMENTS CBR 2™

ORDER CODE **CBR2**

- Real-time graphing of motion data
- Plugs directly into your TI graphing calculator

More on page 99



$y = a \cdot \sin(b(x - c)) + d$

Linear, parabolic, sinusoidal, and more

VERNIER EasyLink®

ORDER CODE **EZ-LINK**

- Direct data collection for your TI-84 Plus calculator or TI-Nspire handheld
- Compatible with over 45 Vernier sensors for even more flexibility

More on page 94

$y = \frac{k}{x}$

Linear, exponential, inverse, and much more

MORE ONLINE
Let us show you how EASY data collection can be:
www.vernier.com/math

1 IT ALL STARTS WITH CURRICULUM

Want to save time? Start with an activity book. Aligned to state and national science and math standards, our books contain experiments for TI graphing calculators (except TI-Nspire) and computers.

2 CHOOSE YOUR INTERFACE

Vernier EasyLink – The least expensive way to collect data using a single sensor. See page 94 for more information.

Vernier LabPro – For use with compatible TI graphing calculators (except TI-Nspire) or computers. See pp. 92–93.

3 CHOOSE OR BUILD YOUR PACKAGE OF SENSORS

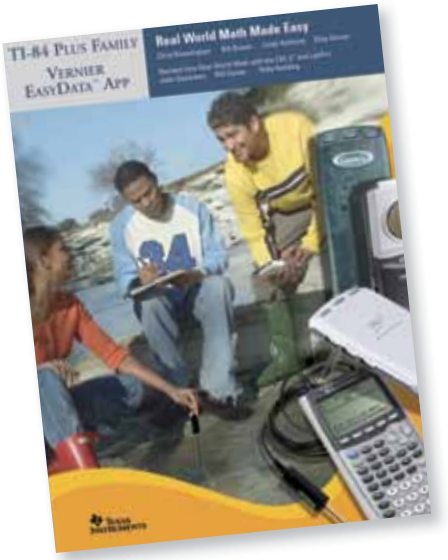
Choose from Vernier's recommended packages or build your own.

Our deluxe package contains all the sensors needed to do every activity in our math book.

Build custom packages online at www.vernier.com/guide

4 ADD A COPY OF LOGGER *PRO*

(Recommended) This award-winning software is the best value around! Logger *Pro* provides the easiest way to get data from a compatible calculator into the computer. See pp. 16–19 for details.



GREAT VALUE

Purchase the Lab Book

ORDER CODE
RWCALC

Vernier lab books are loaded with teacher tips, sample graphs, and more. When you buy the lab book, you will receive:

- Essential teacher information.
- 31 ready-to-use student versions of calculator activities in print.
- A generous site license. Buy one book and duplicate labs for your class.
- Easily edit labs to meet your personal teaching style using Microsoft® Word® files for all of the experiments on CD.
- Suggested answers, sample data, and graphs.
- Complete equipment and supplies list.

***Real World Math Made Easy* activity book contains the following activities:**

☐ **USING A MOTION DETECTOR**
- Straight Line Distance Graphs
- Newton's Second Law *†
- The Linear Force Relation for a Rubber Band *†
- Position and Time for a Cart on a Ramp
- Height and Time for a Bouncing Ball
- Definition of Rate
- Interpreting Velocity Graphs
- Applications of the Distance Formula
- Exponential Pattern of Rebound Heights
- Pendulum Motion
- Damped Harmonic Motion
- Describing Data With Statistical Plots
- Solving a System of Linear Equations
- Plotting an Ellipse
- Parametric Plots
- Piecewise-Defined Functions
- Greatest Integer Functions

☐ **USING A TEMPERATURE PROBE**
- Mixing Liquids of Different Temperatures
- How Hot Objects Cool
- Describing Data with Statistics*

☐ **USING A VOLTAGE PROBE**
- Exponential Models

☐ **USING A LIGHT SENSOR**
- Distance and Intensity
- Periodic Phenomena*

☐ **USING A GAS PRESSURE SENSOR**
- Linear Relationship between Water Depth and Pressure
- Linear Rates of Pressure Increase
- The Inverse Relationship between Pressure and Volume

☐ **USING A MICROPHONE**
- Sound Waveform Models*

☐ **USING A FORCE SENSOR**
- Linear Relationship between Weight and Quantity
- Volume and Weight
- Newton's Second Law *
- The Linear Force Relation for a Rubber Band *

☐ **USING A pH SENSOR**
- The Exponential pH Change
- An Application of the Logistic Function

* Experiment not supported by Easy Package † Requires Deluxe Package

☐ STARTER PACKAGES ☐ DELUXE PACKAGES

Look for training videos of some of these labs at www.vernier.com/videos

ORDER CODE
RWC-LP

***Real-World Math with Computers* activity book**

Includes 29 ready-to-use activities.

ORDER CODE
TI-SV

TI-SmartView™ Emulator Software

Project an interactive representation of a TI-84 Plus calculator to your entire class.

See page 100 for more details.

Math EasyLink and LabPro Packages

Purchase one package per group (2–4 students) OR BUILD YOUR OWN PACKAGE from the list of recommended sensors below.

VERNIER Easy

Calculator Only

EasyLink Interface & Sensors	CODE	Starter Package MATH-EZ-STR	Deluxe Package MATH-EZ-DX
Vernier EasyLink Interface	EZ-LINK	✔	✔
CBR 2 – Motion Detector	CBR2	✔	✔
EasyTemp Temperature Probe	EZ-TMP	✔	✔
Gas Pressure Sensor	GPS-BTA	✔	✔
TI Light Probe	TILT-BTA	✔	✔
Voltage Probe	VP-BTA	✔	✔
TI – Kickstand Slide Cover	TI-KSC	✔	✔
pH Sensor	PH-BTA		✔
Dual-Range Force Sensor	DFS-BTA		✔

EASYLINK **MATH** PACKAGE

You will also need:

Real World Math Made Easy **activity book**
ORDER CODE **RWCALC** See previous page.

Logger *Pro* 3 software, ORDER CODE **LP** ***(recommended)***
Buy just one copy—site license for ALL school and students' personal computers is included! See pp. 16–19 for details.

For a complete list of compatible sensors, go to page 101 or www.vernier.com/easylink

VERNIER LabPro®

Computer or Calculator

LabPro Interface & Sensors	CODE	Starter Package MATH-STR	Deluxe Package MATH-DX
Vernier LabPro Interface	LABPRO	✔	✔
Motion Detector	MD-BTD	✔	✔
Stainless Steel Temperature Probe	TMP-BTA	✔	✔
Gas Pressure Sensor	GPS-BTA	✔	✔
TI Light Probe	TILT-BTA	✔	✔
Voltage Probe (included with LabPro)		✔	✔
pH Sensor	PH-BTA		✔
Dual-Range Force Sensor	DFS-BTA		✔
Microphone	MCA-BTA		✔

LABPRO **MATH** PACKAGE

You will also need:

Real World Math Made Easy **activity book**
ORDER CODE **RWCALC** See previous page.

Logger *Pro* 3 software, ORDER CODE **LP** ***(recommended)***
Buy just one copy—site license for ALL school and students' personal computers is included! See pp. 16–19 for details.

FOR TI CALCULATOR-BASED DATA COLLECTION: see pp. 94–100

FOR COMPUTERS: *Real-World Math For Computers* activity book, ORDER CODE **RWC-LP**
See previous page. **Logger *Pro 3* software,** ORDER CODE **LP** ***(required)***

CBL 2, ORDER CODE **CBL2**
More than 50 Vernier sensors can be connected to the CBL 2. For more details, see page 94.

For CBL 2 packages for math, visit **www.vernier.com/pkgs/cbl2math.html**

TI Nspire Handhelds and Software
Looking for TI Nspire graphing handhelds and software? See page 96 or visit **www.vernier.com/ti-nspire**

Looking for additional TI products? See pp. 94–100.

NEW TI-Nspire™ Lab Cradle
ORDER CODE **TI-NSLABC**
This TI-Nspire sensor interface supports 58 Vernier sensors. The Lab Cradle includes rechargeable battery and AC Adaptor. See page 97 for more details.

1 IT ALL STARTS WITH CURRICULUM

Want to save time? Start with a Vernier lab book. Aligned to state and national science standards, our lab books contain experiments for LabQuest, computers, and TI graphing calculators.

2 CHOOSE YOUR INTERFACE

Vernier LabQuest – LabQuest is our color, touch-screen interface. Use it as a standalone device or as a computer interface. More details on pp. 5–11.

LabQuest Mini – LabQuest Mini is a low-cost computer solution with five sensor ports. More details on pp. 12–13.

Vernier Go!Link – The Go!Link USB interface connects any one of 45 Vernier sensors to your computer. More details on page 14.

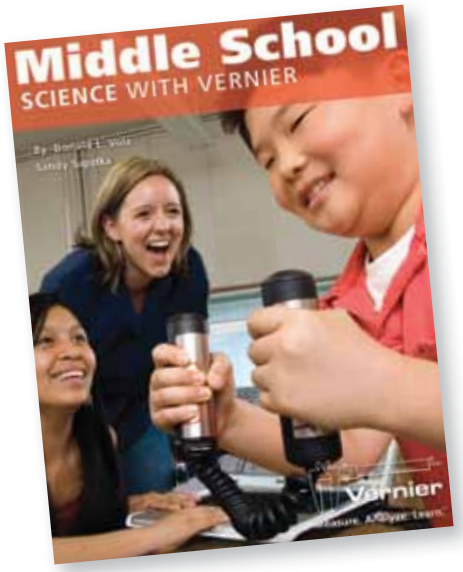
3 CHOOSE YOUR SENSORS

Choose from Vernier's recommended packages or build your own from our list of sensors.

Our Deluxe Package contains all the sensors needed to perform every experiment in our middle school lab book.

4 ADD A COPY OF LOGGER *PRO*

For more advanced users, this award-winning software is the best value around! Includes a site license for all computers in your school, as well as students' personal computers. See pp. 16–19 for details.



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- Essential teacher information.
- 38 ready-to-use student versions of computer experiments in print; LabQuest, computer, and calculator versions on CD.
- A generous site license. Buy one book and duplicate labs for your class.
- Easily edit labs to meet your personal teaching style using Microsoft® Word® files for all versions of the experiments on CD.
- Suggested answers, sample data, and graphs.
- Complete equipment and supplies list.

Features listed above are only available when you purchase the lab book. They are not available in the downloadable evaluation PDF.

DOWNLOAD evaluation PDFs for all labs at **www.vernier.com/labs**

Middle School Science with Vernier lab book contains the following experiments:

USING TEMPERATURE PROBES
- A Hot Hand
- Heating of Land and Water
- The Greenhouse Effect
- Relative Humidity
- Absorption of Radiant Energy
- Schoolyard Study
- A Good Sock
- What Causes the Seasons?
- Solar Homes
- Boiling Temperature of Water
- Freezing Temperature of Water
- How Low Can You Go?
- A Good Cold Pack
- A Water Field Study
- Cooling Rates: Shaq vs. Susie

USING A pH SENSOR
- Soil Study
- A Water Field Study

USING A VOLTAGE PROBE
- Lemon "Juice"

USING A MOTION DETECTOR
- Ocean Floor Mapping
- Graphing Your Motion
- Velocity
- A Speedy Slide
- The Indy 100
- Crash Dummies
- Falling Objects

USING A LIGHT SENSOR
- Reflectivity of Light
- Schoolyard Study

USING A FORCE SENSOR
- Friction
- First-Class Levers
- Pulleys
- Buoyancy

USING A CONDUCTIVITY PROBE
- Water Hardness Study
- Diffusion: How Fast?
- A Water Field Study

USING A GAS PRESSURE SENSOR
- Get a Grip!
- Fun with Pressure
- Yeast Beasts in Action

USING A HAND-GRIP HEART RATE MONITOR
- Heart Rate and Body Position
- Heart Rate and Exercise

USING A MAGNETIC FIELD SENSOR
- Mapping a Magnetic Field
- Electromagnets

STARTER PACKAGES DELUXE PACKAGES

Look for training videos of some of these labs at **www.vernier.com/videos**

Middle School LabQuest and Go!Link Packages

Purchase one package per lab group (2–4 students) OR BUILD YOUR OWN PACKAGE from the list of recommended sensors below.

Standalone or Computer

LabQuest Interface & Sensors	CODE	Starter Package LQ-MS-ST	Deluxe Package LQ-MS-DX
Vernier LabQuest Interface	LABQ	✔	✔
Motion Detector	MD-BTD	✔	✔
pH Sensor	PH-BTA	✔	✔
Voltage Probe	VP-BTA	✔	✔
(2) Stainless Steel Temperature Probes	TMP-BTA	✔	✔
Light Sensor	LS-BTA	✔	✔
Dual-Range Force Sensor	DFS-BTA		✔
Gas Pressure Sensor	GPS-BTA		✔
Hand-Grip Heart Rate Monitor	HGH-BTA		✔
Conductivity Probe	CON-BTA		✔
Magnetic Field Sensor	MG-BTA		✔

LABQUEST **MIDDLE SCHOOL** PACKAGE

You will also need:

Middle School Science with Vernier **lab book**
ORDER CODE **MSV** See previous page.

Logger Lite software, FREE
Included FREE with LabQuest.

Logger *Pro* 3 software *(optional)*, ORDER CODE **LP**
Buy just one copy—site license for all school and students' personal computers is included! See pp. 16–19 for details.

USB Computer Interface

Go! Interface & Sensors	CODE	Starter Package MSS-GO-STR	Deluxe Package MSS-GO-DX
Vernier Go!Link Interface	GO-LINK	✔	✔
Go!Motion	GO-MOT	✔	✔
pH Sensor	PH-BTA	✔	✔
Voltage Probe	VP-BTA	✔	✔
(2) Go!Temp	GO-TEMP	✔	✔
Light Sensor	LS-BTA	✔	✔
Dual-Range Force Sensor	DFS-BTA		✔
Gas Pressure Sensor	GPS-BTA		✔
Hand-Grip Heart Rate Monitor	HGH-BTA		✔
Conductivity Probe	CON-BTA		✔
Magnetic Field Sensor	MG-BTA		✔

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Middle School Science with Vernier **lab book**
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Logger Lite software, FREE
Logger Lite is your easy-to-use, data-collection and graphing software for computers. Included FREE with Go! products.

Logger *Pro* 3 software *(optional)*, ORDER CODE **LP**
Buy just one copy—site license for all school and students' personal computers is included! See pp. 16–19 for details.

FOR TI CALCULATOR-BASED DATA COLLECTION: see pp. 94–100

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2 CHOOSE YOUR INTERFACE

Vernier LabQuest – LabQuest is our color, touch-screen interface. Use it as a standalone device or as a computer interface. More details on pp. 5–11.

LabQuest Mini – LabQuest Mini is a low-cost computer solution with five sensor ports. More details on pp. 12–13.

Vernier Go!Link – The Go!Link USB interface connects any one of 45 Vernier sensors to your computer. More details on page 14.

3 CHOOSE YOUR SENSORS

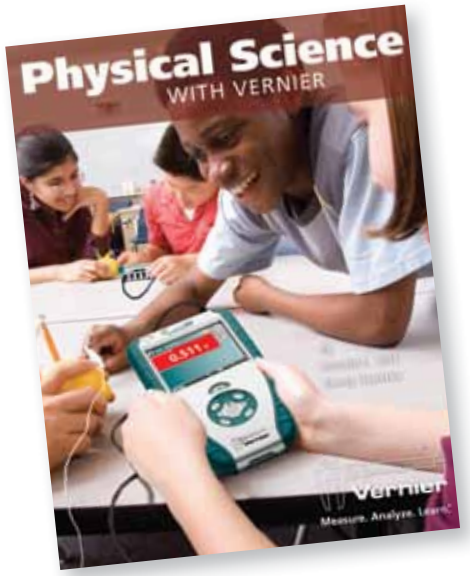
Choose from Vernier's recommended packages or build your own from our list of sensors.

Our Deluxe Package contains all the sensors needed to perform every experiment in our physical science lab book.

Build custom packages online at www.vernier.com/guide

4 ADD A COPY OF LOGGER *PRO*

This award-winning software is the best value around! Includes a site license for all computers in your school or your college department, as well as students' personal computers. See pp. 16–19 for details.



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Vernier lab books are loaded with teacher tips, sample graphs, and more. When you buy the lab book you will receive:

- Essential teacher information.
- 40 ready-to-use student versions of Logger *Pro* experiments in print; LabQuest, computer, and calculator versions on CD.
- A generous site license. Buy one book and duplicate labs for your class.
- Easily edit labs to meet your personal teaching style using Microsoft® Word® files for all versions of the experiments on CD.
- Suggested answers, sample data, and graphs.
- Complete equipment and supplies list.

Features listed above are only available when you purchase the lab book. They are not available in the downloadable evaluation PDF.

DOWNLOAD evaluation PDFs for all labs at **www.vernier.com/labs**

Physical Science with Vernier lab book contains the following experiments:

USING A TEMPERATURE PROBE
- Temperature Probe Response Time
- Boiling Temperature of Water
- ▶ Freezing and Melting of Water
- Evaporation of Alcohols
- Endothermic and Exothermic Reactions
- Neutralization Reactions
- Mixing Warm and Cold Water
- Heat of Fusion
- Energy Content of Fuels
- Energy Content of Foods
- Absorption of Radiant Energy
- An Insulated Cola Bottle
- A Good Sock
- Insolation Angle
- Solar Homes and Heat Sinks
- Gas Temperature & Pressure

USING A MOTION DETECTOR
- Velocity
- It's Race Day
- Momentum: A Crash Lesson
- Newton's Second Law
- Graphing Your Motion
- Falling Objects

USING A pH SENSOR
- Household Acids and Bases
- Acid Rain

USING A VOLTAGE PROBE
- Lemon "Juice"
- Lead Storage Batteries

USING A FORCE SENSOR
- Frictional Forces
- First-Class Levers
- Pulleys
- ▶ An Inclined Plane

USING A LIGHT SENSOR
- ▶ Reflectivity of Light
- Polaroid Filters
- How Bright is the Light?

MAGNETIC FIELD SENSOR
- Electromagnets: Winding Things Up
- Magnetic Field Explorations

USING A CONDUCTIVITY PROBE
- Conducting Solutions
- Conductivity of Salt Water
- Acid Strengths
- Neutralization Reactions

USING A GAS PRESSURE SENSOR
- Gas Pressure and Volume
- Gas Temperature and Pressure
- Fun with Pressure

STARTER PACKAGES DELUXE PACKAGES ▶ VIDEO ONLINE

Interested in Middle School Science? See pp. 62–63.

Physical Science LabQuest and LabQuest Mini Packages

Purchase one package per lab group (2–4 students) OR BUILD YOUR OWN PACKAGE from the list of recommended sensors below.

Standalone or Computer

LabQuest Interface & Sensors	CODE	Starter Package LQ-PS-ST	Deluxe Package LQ-PS-DX
Vernier LabQuest Interface	LABQ	✔	✔
Motion Detector	MD-BTD	✔	✔
Dual-Range Force Sensor	DFS-BTA	✔	✔
pH Sensor	PH-BTA	✔	✔
Voltage Probe	VP-BTA	✔	✔
(2) Stainless Steel Temperature Probes	TMP-BTA	✔	✔
Light Sensor	LS-BTA		✔
Conductivity Probe	CON-BTA		✔
Gas Pressure Sensor	GPS-BTA		✔
Magnetic Field Sensor	MG-BTA		✔

LABQUEST **PHYSICAL SCIENCE** PACKAGE

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ORDER CODE **PSV** See previous page.

Logger *Pro* 3 software, ORDER CODE **LP**
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Computer Only

LabQuest Mini Interface & Sensors	CODE	Starter Package LM-PS-ST	Deluxe Package LM-PS-DX
Vernier LabQuest Mini Interface	LQ-MINI	✔	✔
Motion Detector	MD-BTD	✔	✔
Dual-Range Force Sensor	DFS-BTA	✔	✔
pH Sensor	PH-BTA	✔	✔
Voltage Probe	VP-BTA	✔	✔
(2) Stainless Steel Temperature Probes	TMP-BTA	✔	✔
Light Sensor	LS-BTA		✔
Conductivity Probe	CON-BTA		✔
Gas Pressure Sensor	GPS-BTA		✔
Magnetic Field Sensor	MG-BTA		✔

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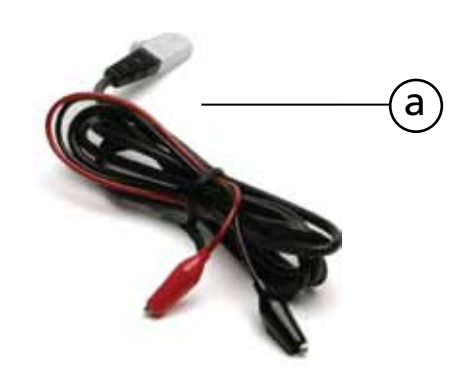


a. Voltage Probe, ORDER CODE VP-BTA

The Voltage Probe can be used to study voltages produced by simple voltaic cells (like the lemon battery at the right), for simple electric circuit labs, or to do battery life studies.

Shown to the right with a Go!Link USB interface and Logger Lite software (included FREE with purchase). See page 120 for more information.

Go!Link, ORDER CODE GO-LINK

---

b. Motion Detector, ORDER CODE MD-BTD

The Motion Detector can be used to study the motion of a cart on a ramp or a ball tossed into the air. You can also use it to teach your students how graphs work by having them try to move in front of the motion detector to match a distance *vs.* time or velocity *vs.* time graph.

- Measure objects as close as 15 cm to the detector and as far away as 6 m.
- Pivoting head and rubber feet for ease of use

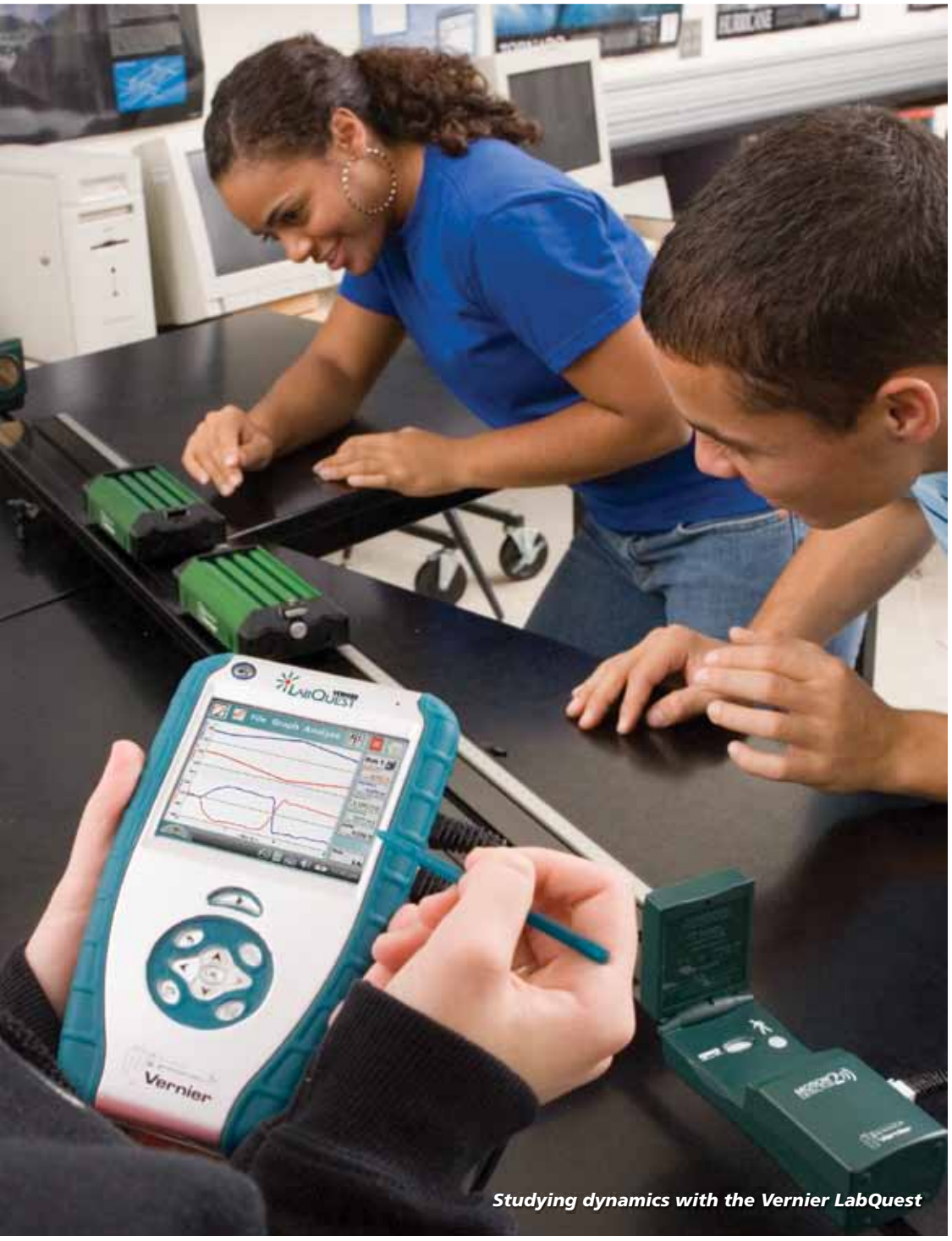
---

c. Light Sensor, ORDER CODE LS-BTA

Our Light Sensor approximates the human eye in spectral response and can be used over three different illumination ranges, which you select with a switch. Use it for inverse square law experiments or for studying polarizers, reflectivity, or solar energy.

***Experiment 33 from* Physical Science with Vernier,**
Measuring the voltage of a lemon battery, "Lemon Juice" lab

Collecting data with a Light Sensor



Studying dynamics with the Vernier LabQuest

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2 CHOOSE YOUR INTERFACE

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LabQuest Mini – LabQuest Mini is a low-cost computer solution with five sensor ports. More details on pp. 12–13.

Vernier LabPro – For data collection with TI graphing calculators, see details on pp. 92–93.

3 CHOOSE YOUR SENSORS

Choose from Vernier's recommended packages or build your own from our list of sensors.

Our Deluxe Package contains all the sensors needed to perform every experiment in our physics lab book.

Build custom packages online at **www.vernier.com/guide**

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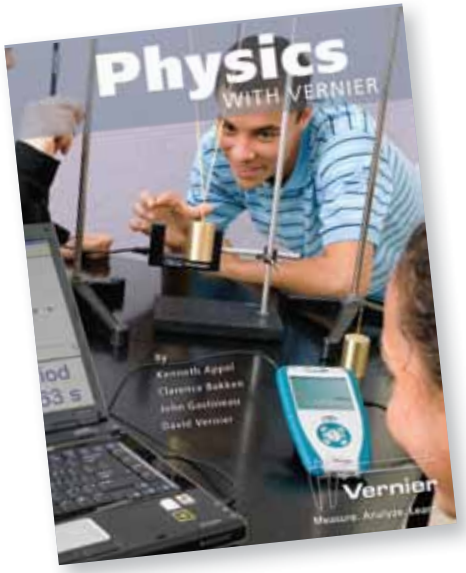

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- 35 ready-to-use student versions of Logger *Pro* experiments in print; LabQuest, computer, and calculator versions on CD.
- A generous site license. Buy one book and duplicate labs for your class.
- Easily edit labs to meet your personal teaching style using Microsoft® Word® files for all versions of the experiments on CD.
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- Complete equipment and supplies list.

Features listed above are only available when you purchase the lab book. They are not available in the downloadable evaluation PDF.

DOWNLOAD evaluation PDFs for all labs at **www.vernier.com/labs**

Physics with Vernier lab book contains the following experiments:

USING A MOTION DETECTOR
- Graph Matching
- Cart on a Ramp
- Determining *g* on an Incline
- Ball Toss
- ▶ Air Resistance
- Simple Harmonic Motion
- Energy of a Tossed Ball
- Energy in Simple Harmonic Motion
- Momentum, Energy and Collisions
- Impulse and Momentum
- Back and Forth Motion

USING A FORCE SENSOR
- Newton's Second Law
- Newton's Third Law
- Static and Kinetic Friction
- Impulse and Momentum

USING A MICROPHONE
- Sound Waves and Beats
- Tones, Vowels and Telephones
- Mathematics of Music
- Speed of Sound

USING A VOLTAGE PROBE
- Capacitors

USING PHOTOGATES
- Picket Fence Free Fall
- Projectile Motion
- Atwood's Machine
- Pendulum Periods

USING A TEMPERATURE PROBE
- Newton's Law of Cooling

USING AN ACCELEROMETER
- ▶ Bungee Jump Accelerations
- Centripetal Accelerations on a Turntable
- Accelerations in the Real World
- Newton's Second Law

USING CURRENT & VOLTAGE PROBES
- Ohm's Law
- Series and Parallel Circuits
- Electrical Energy

USING A MAGNETIC FIELD SENSOR
- The Magnetic Field in a Coil
- The Magnetic Field in a Slinky
- The Magnetic Field of a Permanent Magnet

USING A LIGHT SENSOR
- Polarization of Light
- How Light Intensity Varies with Distance

☐ STARTER PACKAGES ▣ DELUXE PACKAGES ▶ VIDEO ONLINE

Look for training videos of some of these labs at **www.vernier.com/videos**

Physics LabQuest and LabQuest Mini Packages

Purchase one package per lab group (2–4 students) OR BUILD YOUR OWN PACKAGE from the list of recommended sensors below.

Standalone or Computer

LabQuest Interface & Sensors	CODE	Starter Package LQ-PHY-ST	Deluxe Package LQ-PHY-DX
Vernier LabQuest Interface	LABQ	✔	✔
Motion Detector	MD-BTD	✔	✔
Dual-Range Force Sensor	DFS-BTA	✔	✔
Microphone	MCA-BTA	✔	✔
Differential Voltage Probe	DVP-BTA	✔	✔
Low-g Accelerometer	LGA-BTA		✔
Light Sensor	LS-BTA		✔
(2) Vernier Photogates	VPG-BTD		✔
Ultra Pulley Attachment	SPA		✔
Picket Fence	PF		✔
Stainless Steel Temperature Probe	TMP-BTA		✔
Magnetic Field Sensor	MG-BTA		✔
(2) Current Probes	DCP-BTA		✔

LABQUEST **PHYSICS** PACKAGE

You will also need:

***Physics with Vernier* lab book,** ORDER CODE **PWV**
See previous page.

Logger *Pro* 3 software, ORDER CODE **LP**
Buy just one copy—site license for all school and students' personal computers is included! See pp. 16–19 for details.

Computer Only

LabQuest Mini Interface & Sensors	CODE	Starter Package LM-PHY-ST	Deluxe Package LM-PHY-DX
Vernier LabQuest Mini Interface	LQ-MINI	✔	✔
Motion Detector	MD-BTD	✔	✔
Dual-Range Force Sensor	DFS-BTA	✔	✔
Microphone	MCA-BTA	✔	✔
Differential Voltage Probe	DVP-BTA	✔	✔
Low-g Accelerometer	LGA-BTA		✔
Light Sensor	LS-BTA		✔
(2) Vernier Photogates	VPG-BTD		✔
Ultra Pulley Attachment	SPA		✔
Picket Fence	PF		✔
Stainless Steel Temperature Probe	TMP-BTA		✔
Magnetic Field Sensor	MG-BTA		✔
(2) Current Probes	DCP-BTA		✔

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You can go wireless for force and acceleration by going to www.vernier.com/wirelessphysics

1 IT ALL STARTS WITH CURRICULUM

Want to save time? Start with a Vernier lab book. Aligned to state and national science standards, our lab books contain experiments for LabQuest and computers.

2 CHOOSE YOUR INTERFACE

Vernier LabQuest – LabQuest is our color, touch-screen interface. Use it as a standalone device or as a computer interface. LabQuest is the recommended interface for Advanced Physics. More details on pp. 5–11.

LabQuest Mini – LabQuest Mini is a low-cost computer solution with five sensor ports. More details on pp. 12–13.

3 CHOOSE YOUR SENSORS AND ACCESSORIES

Choose from Vernier's recommended package or build your own from our list of sensors.

Our Mechanics Packages contain all the sensors needed to perform every experiment in our advanced physics lab book. Our corresponding Advanced Physics Accessory Package includes the Vernier accessories needed to perform the experiments.

Build custom packages online at www.vernier.com/guide

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This award-winning software is the best value around! Includes a site license for all computers in your school or your college department, as well as students' personal computers. See pp. 16–19 for details.

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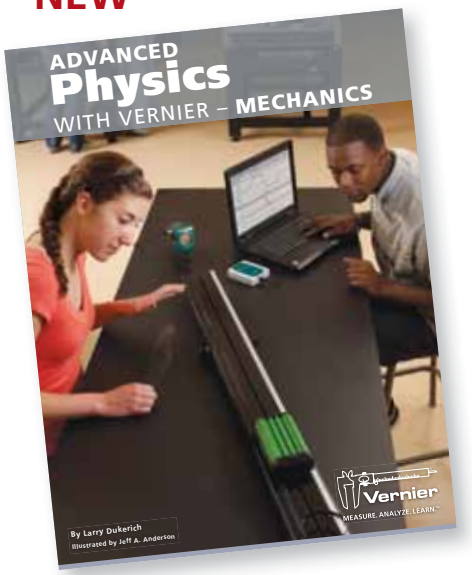

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Purchase the Lab Book

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PHYS-AM

Student Editions Available
www.vernier.com/studenteditions

New for 2011: *Advanced Physics with Vernier – Mechanics* is the first of a two-volume set of new experiments for the more in-depth introductory physics course, such as college physics, AP Physics, or IB Physics.

- Experiments are designed for an interactive teaching style, with planned moments for instructor or student-led discussion.
- Instructor notes include discussion on how to lead students to a successful activity.
- Includes many extensions to challenge the most talented students.
- Microsoft® Word® files of student experiments and supporting materials on CD.
- Includes a site license.
- Instructions are written to support data collection in Logger *Pro* or LabQuest App.

Features listed above are only available when you purchase the lab book. They are not available in the downloadable evaluation PDF.

DOWNLOAD evaluation PDFs for all labs at www.vernier.com/labs

***Advanced Physics with Vernier – Mechanics* lab book contains the following experiments:**

	Experiment	Sensors Used	Required Vernier Accessories
1	Motion on an Incline	Motion Detector	VDS
2	Error Analysis	Vernier Photogate	PF
3	Newton's First law	Motion Detector	VDS, PAD-VDS, BLK
4	Newton's Second Law	Vernier Photogate, Dual-Range Force Sensor	VDS, BLK, PF-CART, SPA, B-SPA
5	Newton's Third Law	(2) Dual-Range Force Sensors	VDS, PAD-VDS, BLK
6	Projectile Motion	Video Analysis in Logger *Pro*	
7	Conservation of Energy (Elastic)	Dual-Range Force Sensor	VDS, PAD-VDS, BLK
8	Conservation of Energy (Kinetic)	Vernier Photogate	VDS, PAD-VDS, BLK, PF-CART
9	Conservation of Energy (Gravitational)		VDS, PAD-VDS, BLK
10A	Impulse and Momentum	Motion Detector, Dual-Range Force Sensor	VDS, PAD-VDS, BLK
10B	Impulse and Momentum	Vernier Photogate, Dual-Range Force Sensor	VDS, PAD-VDS, BLK
11A	Momentum and Collisions	(2) Motion Detectors	VDS
11B	Conservation of Momentum in a Collision	(2) Vernier Photogates	VDS, (2) PF-CART
12A	Centripetal Acceleration	Vernier Photogate, Dual-Range Force Sensor	CFA
12B	Centripetal Acceleration	Vernier Photogate, Dual-Range Force Sensor	
13	Rotational Dynamics	Rotary Motion Sensor	AK-RMV
14	Conservation of Angular Momentum	Rotary Motion Sensor	AK-RMV
15	Simple Harmonic Motion - Mathematical Model	Motion Detector	
16	Simple Harmonic Motion - Kinematics and Dynamics	Motion Detector, Dual-Range Force Sensor	
17	Pendulum Periods	Rotary Motion Sensor	AK-RMV
18	Physical Pendulum	Rotary Motion Sensor	AK-RMV
19	Center of Mass Acceleration	Video Analysis in Logger *Pro*	

Advanced Physics Mechanics Package

Purchase one package per lab group (2–4 students) OR BUILD YOUR OWN PACKAGE from the list of recommended sensors below.

Interface & Sensors		CODE	LabQuest Package LQ-PHY-MEC	LabQuest Mini Package LM-PHY-MEC
CHOOSE ONE	**LabQuest**	LABQ	✔	—
	LabQuest Mini (computer)	LQ-MINI	—	✔
(2) Motion Detectors		MD-BTD	✔	✔
(2) Vernier Photogates		VPG-BTD	✔	✔
(2) Dual-Range Force Sensors		DFS-BTA	✔	✔
Rotary Motion Sensor		RMV-BTD	✔	✔

You will also need:

Advanced Physics with Vernier – Mechanics **lab book**
ORDER CODE **PHYS-AM** See previous page.

Logger *Pro* 3 software, ORDER CODE **LP**
Buy just one copy—site license for all school and students' personal computers is included! See pp. 16–19 for details.

Accessories listed below.

LABQUEST or **LABQUEST MINI** | ADVANCED PHYSICS MECHANICS **LABQUEST** PACKAGE | ADVANCED PHYSICS MECHANICS **LABQUEST MINI** PACKAGE

NEW Centripetal Force Apparatus

The Centripetal Force Apparatus allows you to investigate the relationship between centripetal force, angular velocity, mass, and radius. A force sensor measures the centripetal force exerted on a mass as it moves in a circle. A photogate can be used to measure the angular speed. Different masses can be added to the platform and positioned at variable radii. The platform can be driven by a falling mass. The apparatus also accommodates the Vernier Wireless Dynamic Sensor System to measure force, which provides the best set of data. (Sensors are sold separately.)

ORDER CODE
CFA

Advanced Physics Accessories

Extensive use is made of these accessories in our advanced physics lab manual and they are highly recommended. Refer to the list of experiments on the opposite page.

Vernier Dynamics System	VDS
Ultra Pulley Attachment	SPA
Pulley Bracket	B-SPA
Bumper and Launcher Kit	BLK
Cart Friction Pad	PAD-VDS
Picket Fence	PF
(2) Cart Picket Fences	PF-CART
Rotary Motion Accessory Kit	AK-RMV
Centripetal Force Apparatus	CFA

a. Power Amplifier, ORDER CODE PAMP

The Vernier Power Amplifier allows you to drive loads with ±10 V and currents up to 1 A. Works with any waveform, including DC, sine, square, triangle, and sawtooth waveforms. The Power Amplifier can drive a variety of loads, including speakers, lamps, small DC motors, and RLC circuits. More on page 114.

b. Power Amplifier Accessory Speaker

ORDER CODE PAAS-PAMP

This kit includes a speaker and accessories used with the Vernier Power Amplifier to study mechanical waves and springs. The speaker contains a lightweight metal disc glued to the speaker cone. A drive post attached to the metal plate allows you to drive elastic materials such as strings and springs.

c. Rotary Motion Sensor

ORDER CODE RMV-BTD

Our Rotary Motion Sensor lets you monitor angular motion precisely and easily and is direction sensitive. Use it to collect angular displacement, angular velocity, and angular acceleration data.

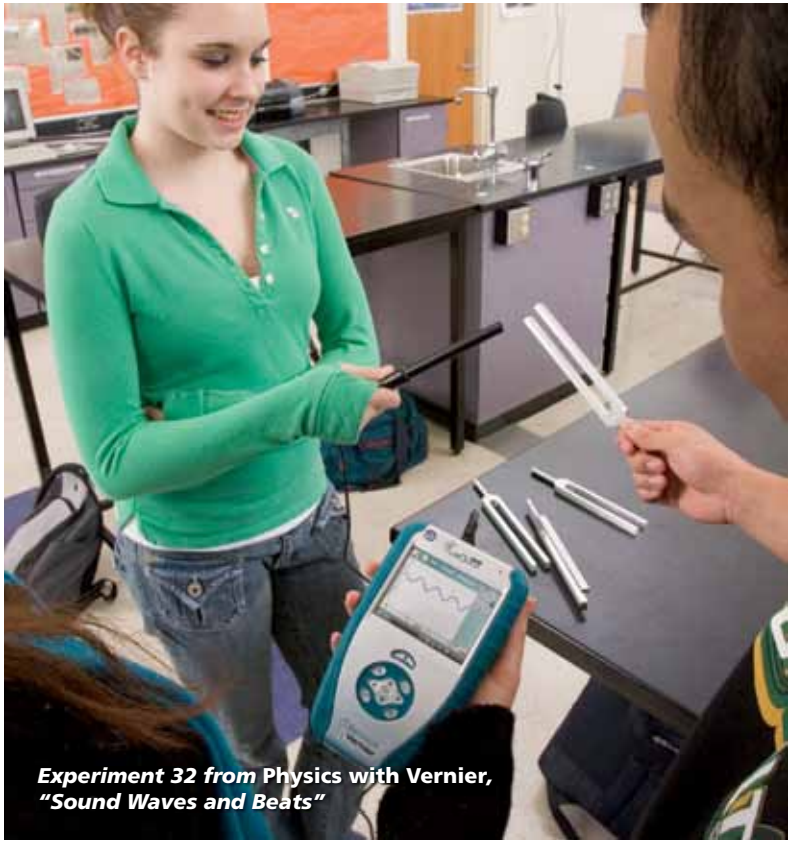
d. Rotary Motion Accessory Kit

ORDER CODE AK-RMV

This accessory kit is used to study the motion of a physical pendulum; the rotational inertia of disks, rings, and point masses; and the conservation of angular momentum.

e. Force Plate, ORDER CODE FP-BTA

The Force Plate is a large force sensor—tough enough to jump on. About the size and shape of a bathroom scale, the Force Plate has two ranges: one reading up to 3500 N, and the other to 800 N. Two handles are included for pushing or pulling. Additional pairs of handles are available (ORDER CODE FP-HAN).



Experiment 32 from* Physics with Vernier, *"Sound Waves and Beats"

Exploring Newton's Third Law

Analyzing gas tube emission spectra

NEW Spectrum Tube Carousel Power Supply

ORDER CODE **ST-CAR**

The Spectrum Tube Carousel Power Supply features the same ultra-safe, patent-pending design of the Single version, but holds eight gas spectrum tubes simultaneously. You can quickly switch from one gas to another without handling the tubes. Includes a Carousel Spectrum Tube Fiber Optic Holder.

The Red Tide Emissions Spectrometer and Optical Fiber are used here with the Spectrum Tube Carousel Power Supply

f. Red Tide Emissions Spectrometer

ORDER CODE **ESRT-VIS**

The perfect tool to conduct emissions analysis and much more. It connects directly to your computer with a standard USB cable and gives precise measurements over a range of 380–950 nm. Use the Red Tide Emissions Spectrometer with a recommended Optical Fiber Assembly to add versatility and allow a greater range of analysis options. More on page 41.

See www.vernier.com/spectroscopy for details.

g. Optical Fiber, ORDER CODE VIS-NIR

400 µm diameter VIS-NIR Optical Fiber. Delivers consistent results with minimal signal variance.

h. Spectrum Tube Single Power Supply

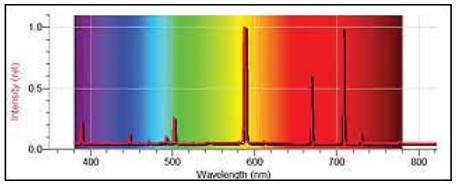
ORDER CODE **ST-SPS**

The Spectrum Tube Single Power Supply provides an ultra-safe means of generating gas discharges. View the spectral lines with any of our spectrometers. With no exposed high voltage, tubes are permanently enclosed in protective plastic carriers. There are no through-the-glass electrodes, so tubes are long lasting. One tube is energized at a time, and there are storage slots for six more tubes. Includes a Spectrum Tube Fiber Optic Holder. All tubes sold separately.

Spectrum Tube

Hydrogen	**ST-H**
Nitrogen	**ST-N**
Helium	**ST-HE**
Neon	**ST-NE**
Carbon Dioxide	**ST-CO2**
Air	**ST-AIR**
Argon	**ST-AR**

f



g

VIS-NIR Optical Fiber

h

a. Vernier Circuit Board, ORDER CODE VCB

The Vernier Circuit Board is a simple board that makes it easy to create circuits without a lot of loose components. Includes a resettable fuse, two powering options, resistors, capacitors, an LED, lamps, and binding posts to add your own components.

b. Extech Digital DC Power Supply

ORDER CODE EXPS

The Extech Digital DC Power Supply is an excellent choice for the physics classroom. It has three outputs: adjustable 0–30 V at 0–3 A, fixed 5 V, and fixed 12 V. It provides constant current or constant voltage modes and has overload and short circuit protection. Binding post terminals are provided for the variable supply. Easy snap terminals are provided for the 5 V and 12 V outputs. The front panel contains digital voltage and current meters for the variable output, so you won't need additional metering in a typical experiment.

c. Digital Radiation Monitor

ORDER CODE DRM-BTD

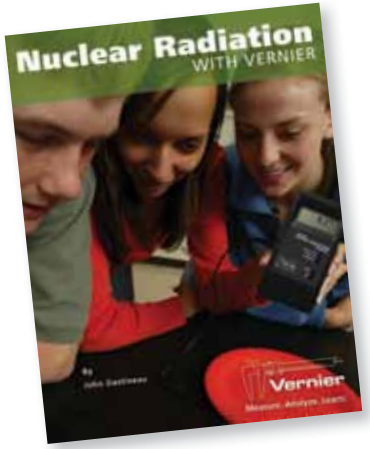
The Digital Radiation Monitor consists of a Geiger-Mueller tube and a digital rate meter mounted in a small, rugged, plastic case with a digital meter. The unit is battery operated and can be used with or without a computer for measurement of alpha, beta, and gamma radiation. It can be used to explore radiation statistics and to measure the rate of nuclear decay.

d. Photogate Bar Tape Kit

ORDER CODE TAPE-VPG

The Photogate Bar Tape Kit contains a flexible plastic tape called "Bar Tape" and a guide that allows the tape to be used with a Vernier Photogate. The tape can be attached to objects and pulled through the photogate. This allows you to perform experiments as you would with a ticker tape timer.

Students studying Ohm's law using the Current Probe, Differential Voltage Probe, and the Vernier Circuit Board



Nuclear Radiation with Vernier

by John Gastineau

ORDER CODE
NRV

This book contains six experiments for data collection with a radiation monitor including Distance and Radiation, Counting Statistics, Lifetime Measurement, Background Radiation Sources, Radiation Shielding, and Alpha, Beta, and Gamma.

NEW Color Mixer for the Vernier Dynamics System

A new Color Mixer accessory for the Vernier Dynamics System is now available. The kit consists of a three-color LED source, a lens, and a screen. These all attach to a Vernier Track and can be used to study the mixing of red, blue, and green light by additive and subtractive mixing. These simple experiments show how modern computer and television displays work.

Now you can actually do, rather than describe, these interesting experiments.

The intensity of each LED can be controlled easily, demonstrating color addition. For subtraction, you can create shadows by placing objects in the light path.

ORDER CODE
CM-OEK

d. Charge Sensor

ORDER CODE **CRG-BTA**

The Charge Sensor is used as an electronic electroscope. An extremely high impedance voltage sensor with a 0.01 µF input capacitor makes possible quantitative measurements in many electrostatic experiments. The sensor has three operating ranges and a zeroing switch to discharge the input capacitor. For detailed specifications see page 103.

e. Electrostatics Kit

ORDER CODE **ESK-CRG**

The Electrostatics Kit is an accessory for the Vernier Charge Sensor. This kit allows students to perform a range of experiments in electrostatics including the use of Faraday's Ice Pail, quantitative and qualitative measurement of charge, charging by friction, charging by contact and charging by induction. The kit includes

- Faraday pail and cage
- Grounding plane
- Grounding wires and wrist strap
- Charge producers and proof plane
- Wool, vinyl, nylon rod, PVC rod
- Cotton cloth

f. High Voltage Electrostatics Kit

ORDER CODE **HVEK-CRG**

The High Voltage Electrostatics Kit is an accessory for the Vernier Charge Sensor. Use it with a Faraday Pail and the Charge Sensor to investigate the distribution of charge on a sphere, transfer of charge on contact between two spheres and charging by induction. The kit includes an electrostatics voltage source (Output 750, 1500, 3000, 6000 VDC) and two conducting spheres. Extremely low output current makes this device safe for classroom use.

Vernier Dynamics Carts

- Perfect for kinematics and dynamics experiments.
- Easily attach a Dual-Range Force Sensor or our Wireless Dynamics Sensor System.
- Use them with our Motion Detector.
- Roll the cart down a ramp to study constant acceleration.
- Use two carts to study momentum conservation.
- With extremely low friction due to sealed bearings and machined wheels, our superior carts give very high quality data.
- Interchangeable magnetic and VELCRO® end caps make it possible to do many experiments.
- The Plunger Cart has a spring-loaded plunger for consistent collisions, while the Standard Cart is similar, but has no plunger.
- Vernier carts are compatible with other common carts and tracks.

Experiments for Cart and Track

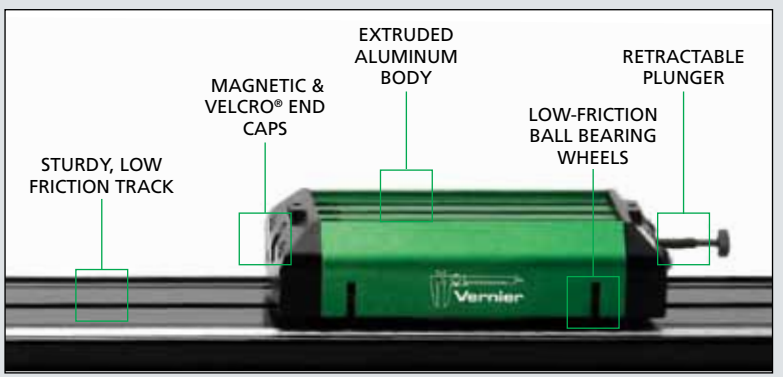
- Measuring *g* on an Incline
- Newton's Second Law
- Momentum, Energy, and Collisions
- Impulse and Momentum

These experiments can be found in our lab book Physics with Vernier *(see page 68).*

Dynamics Cart with WDSS attached

Dual-Range Force Sensor and Accelerometer

For Wireless Dynamic Sensor System see page 79.



2.2 m Track

ORDER CODE
TRACK-LONG

Optics Expansion Kit

ORDER CODE
OEK

Add the Vernier Optics Expansion Kit to your dynamics track to conduct optics experiments, such as image formation with lenses and light intensity *vs.* distance. You can even use the kit to build a basic telescope.

Vernier Optics Expansion Kit Includes:

- Three lens holders with bases
- 100 mm converging lens
- 200 mm converging lens
- -150 mm diverging lens
- Screen, holder, and base
- Combination luminous and point light source
- Light sensor holder
- Aperture screen
- Power Supply

Bumper and Launcher Kit

ORDER CODE
BLK

Contains accessories for experiments involving the Vernier Dual-Range Force Sensor, Vernier Wireless Dynamics System, and the Vernier Dynamics System. The accessories allow you to perform a wide range of experiments in kinematics and dynamics.

Vernier Bumper and Launcher Kit Includes:

- One track bracket
- One dual-magnet bumper
- One DFS end mount screw
- Two magnetic bumpers
- Two rubber bumpers
- Two hoop bumpers
- Two clay holders
- One small brick of clay

Vernier Dynamics System

ORDER CODE
VDS

Use the Vernier Dynamics System to improve your kinematics and dynamics experiments. The Dynamics System is ideal for studying Newton's second law, acceleration on an inclined plane, momentum, and much more. Vernier sensors such as our Motion Detector, Dual-Range Force Sensor, Wireless Dynamics Sensor System, Photogate, and Accelerometer easily attach to the Dynamics System. Make the most of your track by adding the Vernier Optics Expansion Kit for studying optics. You can even couple two tracks together with our Track-to-Track Coupler.

Vernier Dynamics System Includes:

- Combination 1.2 m Dynamics Track/Optics Bench
- Standard Cart with Magnetic and VELCRO End Caps
- Plunger Cart with Magnetic and VELCRO End Caps
- Mass – 500 g
- Two Adjustable Two Foot Levelers
- Adjustable End Stop
- Motion Detector Bracket
- Two Photogate Brackets
- Rod Clamp

NEW Vernier Dynamics System – Long Track, ORDER CODE **VDS-LONG**

The long-track version includes the same carts and accessories as the standard system, but substitutes a 2.2 m track for the 1.2 m track.

Optics Expansion Kit

ORDER CODE
OEK

Cart Fan

ORDER CODE
FAN-VDS

Friction Pad

ORDER CODE
PAD-VDS

Pulley Bracket

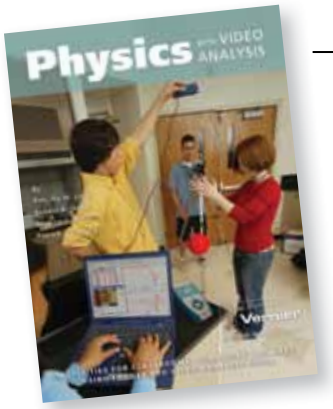
ORDER CODE
B-SPA

Ultra Pulley Attachment

ORDER CODE
SPA

MORE Dynamics System Accessories

Additional 1.2 m Track, ORDER CODE **TRACK**
Standard Cart, ORDER CODE **CART-S**
Plunger Cart, ORDER CODE **CART-P**
Mass – 500 g, ORDER CODE **MASS**
Cart Picket Fence, ORDER CODE **PF-CART**



a

a. *Physics with Video Analysis*

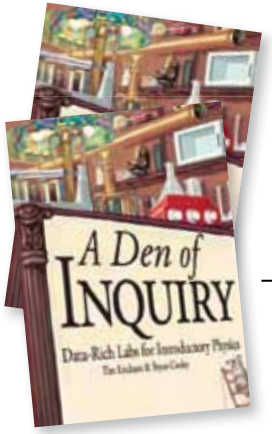
ORDER CODE **PVA**

by Priscilla Laws, Robert Teese, Maxine Willis, and Patrick Cooney

Physics with Video Analysis contains a wide selection of video analysis activities for introductory physics at either the high school or college level. Topics include kinematics, dynamics, circuits, sound, electrostatics, and more. Includes a CD with professionally made videos, student activities, solutions, and Logger *Pro* setup files.

MORE ONLINE
Free sample activities and videos are available now at
www.vernier.com/livephoto

A Den of Inquiry *by Tim Erikson*



b

c

b. Volume 1, ORDER CODE DEN

Fifteen labs for introductory physics. These labs emphasize data analysis and mathematical modeling, but they do not require sensors. The book includes files and instructions for Logger *Pro* and for Fathom. Each lab includes teacher notes and black line masters.

c. Volume 2, ORDER CODE DEN2

Sixteen sensor-based activities for introductory physics. Topics include kinematics, mechanics and energy; activities emphasize data analysis and modeling. Either Fathom 2.1 or Logger *Pro* software can be used.

Additional physics curriculum

For details on the following, see
www.vernier.com/cmat

- Tools for Scientific Thinking
- RealTime Physics Activity Guides
- Workshop Physics
- Understanding Physics
- Interactive Lecture Demonstrations
- Activity-Based Physics High School CD

NEW Vernier Video Physics for iPhone®, iPod touch®, and iPad™

Vernier Video Physics brings video analysis to iPhone, iPod touch, and iPad. Track an object, set the scale, and see graphs of trajectory, position, and velocity. See page 20 for more information.

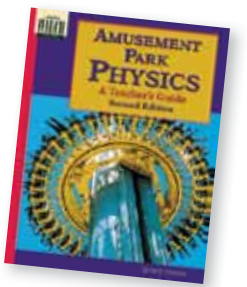
iPad photo courtesy of Apple

Available on the App Store

Amusement Park Physics

Amusement Park Physics, ORDER CODE **APP**

by Nathan Unterman



This book provides a wealth of information about planning an amusement park study program. Included are student sheets for activities that can be performed at amusement parks or carnivals. Activities and sample data are provided for those who do not have access to an amusement park.

Download a free guide to using our equipment at amusement parks:
www.vernier.com/cmat/datapark.html

Data Vest, ORDER CODE DV

The Data Vest makes hands-free data collection at an amusement park or playground easy. The vest has a front pouch for the LabQuest, LabPro, CBL 2, or the Wireless Dynamics Sensor System. It has two inside pockets for the sensors, and side straps to hold the vest in place.

Fathom Dynamic Data™ Software

Bring a new dynamic dimension to experiments with Fathom, fitting functions to data is powerfully easy to do! Compatible with Vernier sensors. For more information see www.vernier.com/fathom

A Completely Wireless Sensor System

The Wireless Dynamics Sensor System combines a 3-axis accelerometer, force sensor, and altimeter into one unit that communicates wirelessly with your computer via Bluetooth®. You can also use it as a standalone data logger. It's more than just a wireless sensor; it's a complete data-collection system completely free of friction due to cables.

Wireless Dynamics Sensor System

ORDER CODE **WDSS**

Includes rechargeable battery and charger, bumpers for collisions, hooks for mounting either end of the unit in different positions, mounting hardware for Vernier and other dynamics carts, and manual.

You will also need:

- Logger *Pro* 3.5 software (or newer)
- Windows XP SP2 (or newer) or Vista Macintosh OS X 10.3 (or newer)
- Bluetooth® wireless technology enabled computer (see www.vernier.com/wdss for supported devices)

Bluetooth USB Dongle Radio

ORDER CODE **BLUE-USB**

Each computer used with a WDSS must have a Bluetooth radio. This convenient USB dongle adds Bluetooth capabilities to any Windows XP SP2, Vista, Windows 7, or Mac OS X 10.4 or newer computer that lacks Bluetooth.

Wireless Dynamics Sensor System

Altimeter
Record changes in altitude for roller-coaster physics.

3-Axis Accelerometer
Three orthogonally mounted sensors let you measure acceleration in all directions.

Data-Collection Status

Communication Status

On-Board Memory
Retains data even after the unit is turned off.

Multiple Mounting Options
Mount the device in almost any orientation using standard hardware.

Battery Charging Indicator

Start/Stop Collection Button
Simple, one-button operation allows you to start and stop data collection when away from the computer.

Force Sensor
Custom load cell provides accurate, repeatable results.

Additional Hook
Allows the device to be mounted in-line for tension and pendulum experiments.

ORDER CODE
WDSS

- Measures acceleration, force, and altitude
- Wireless real-time data collection
- Works as a standalone data logger

WIRELESS DYNAMICS SENSOR SYSTEM
FORCE • ACCELERATION • ALTITUDE

SPECIFICATIONS
INTERNAL DATA STORAGE CAPACITY: 240,000 points
MAXIMUM SAMPLING RATE: 1000 samples/second

FORCE
RANGE: ±50 N
RESOLUTION: 0.006 N (<10 N)
0.03 N (>10 N)

ACCELEROMETERS
(FOR EACH AXIS)
RANGE: ±50 m/s² (±5 g)
RESOLUTION: 0.04 m/s²

ALTIMETER
ALTITUDE CHANGE RANGE: +/-200 m
RESOLUTION: 1 m

For a complete package that includes the WDSS, go to www.vernier.com/wirelessphysics

1 IT ALL STARTS WITH CURRICULUM

Want to save time? Start with a Vernier lab book. Aligned to state and national science standards, our lab books contain experiments for LabQuest and computers.

2 CHOOSE YOUR INTERFACE

Vernier LabQuest – LabQuest is our color, touch-screen interface. Use it as a standalone device or as a computer interface. More details on pp. 5–11.

LabQuest Mini – LabQuest Mini is a low-cost computer solution with five sensor ports. More details on pp. 12–13.

3 CHOOSE YOUR SENSORS

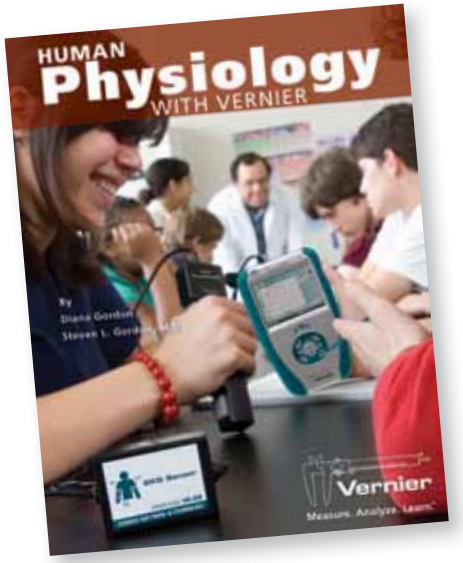
Choose from Vernier's recommended packages or build your own from our list of sensors.

Our Deluxe Package contains all the sensors needed to perform every experiment in our physiology lab book.

Build custom packages online at www.vernier.com/guide

4 ADD A COPY OF LOGGER *PRO*

This award-winning software is the best value around! Includes a site license for all computers in your school or your college department, as well as students' personal computers. See pp. 16–19 for details.



GREAT VALUE

Purchase the Lab Book

ORDER CODE
HP-A

Student Editions Available
www.vernier.com/studenteditions

Vernier lab books are loaded with teacher tips, sample graphs, and more. When you buy the lab book you will receive:

- Essential teacher information.
- 24 ready-to-use student versions of Logger *Pro* experiments in print; LabQuest and computer versions on CD.
- A generous site license. Buy one book and duplicate labs for your class.
- Easily edit labs to meet your personal teaching style using Microsoft® Word® files for all versions of the experiments on CD.
- Suggested answers, sample data, and graphs.
- Complete equipment and supplies list.

Features listed above are only available when you purchase the lab book. They are not available in the downloadable evaluation PDF.

DOWNLOAD evaluation PDFs for all labs at www.vernier.com/labs

Human Physiology with Vernier lab book contains the following experiments:

USING A SURFACE TEMPERATURE SENSOR
- Warming Function of Nasal Passageways
- Effect of Vascularity on Skin Temperature Recovery

USING A BLOOD PRESSURE SENSOR
- Blood Pressure as a Vital Sign
- Blood Pressure and Exercise
- Diurnal Blood Pressure Variation
- Heart Rate and Blood Pressure as Vital Signs
- Heart Rate, Blood Pressure, and Exercise

USING A HEART RATE MONITOR
- Heart Rate as a Vital Sign
- Heart Rate and Exercise
- Heart Rate Response to Baroreceptor Feedback
- Effect of Coughing on Heart Rate
- Heart Rate and Blood Pressure as Vital Signs
- Heart Rate, Blood Pressure, and Exercise

USING A HAND DYNAMOMETER
- Grip Strength Comparison
- Grip Strength and Muscle Fatigue
- EMG and Muscle Fatigue

USING AN EKG SENSOR
- Analyzing the Heart with EKG
- Introduction to EMG
- Neuromuscular Reflexes (with Accelerometer)
- Neuromuscular Reflexes (without Accelerometer)
- Muscle Function Analysis
- EMG and Muscle Fatigue

USING A SPIROMETER
- Lung Volumes and Capacities
- Respiratory Response to Physiologic Challenges
- Analysis of Lung Function
- Oxygen and Aerobic Metabolism

USING AN O_2 GAS SENSOR
- Oxygen and Aerobic Metabolism
- Oxygen Extraction by the Lungs
- Effect of "Dead Space" on Oxygen Exchange

USING A 25-G ACCELEROMETER
- Neuromuscular Reflexes (with Accelerometer)

STARTER PACKAGES | DELUXE PACKAGES | VIDEO ONLINE

Look for training videos of some of these labs at www.vernier.com/videos

Did you know?

CO_2 Gas Sensor, ORDER CODE **CO2-BTA** The CO_2 Gas Sensor can be used to measure human respiration. The high range can measure up to 100,000 ppm, while the low range, with a maximum of 10,000 ppm, still gives the precision you need for smaller changes in CO_2 gas concentration. The CO_2 Gas Sensor makes a great addition to your human physiology labs.

Physiology LabQuest and LabQuest Mini Packages

Purchase one package per lab group (2–4 students) OR BUILD YOUR OWN PACKAGE from the list of recommended sensors below.

Standalone or Computer

LabQuest Interface & Sensors	CODE	Starter Package LQ-HP-ST	Deluxe Package LQ-HP-DX
Vernier LabQuest Interface	LABQ	✔	✔
EKG Sensor	EKG-BTA	✔	✔
Hand-Grip Heart Rate Monitor	HGH-BTA	✔	✔
Surface Temperature Sensor	STS-BTA	✔	✔
Blood Pressure Sensor	BPS-BTA	✔	✔
Hand Dynamometer	HD-BTA	✔	✔
Spirometer	SPR-BTA		✔
O_2 Gas Sensor	O2-BTA		✔

LABQUEST **PHYSIOLOGY** PACKAGE

You will also need:

Human Physiology with Vernier **lab book**
ORDER CODE **HP-A** See previous page.

Logger *Pro* 3 software, ORDER CODE **LP**
Buy just one copy—site license for ALL school and students' personal computers is included! See pp. 16–19 for details.

Computer Only

LabQuest Mini Interface & Sensors	CODE	Starter Package LM-HP-ST	Deluxe Package LM-HP-DX
Vernier LabQuest Mini Interface	LQ-MINI	✔	✔
EKG Sensor	EKG-BTA	✔	✔
Hand-Grip Heart Rate Monitor	HGH-BTA	✔	✔
Surface Temperature Sensor	STS-BTA	✔	✔
Blood Pressure Sensor	BPS-BTA	✔	✔
Hand Dynamometer	HD-BTA	✔	✔
Spirometer	SPR-BTA		✔
O_2 Gas Sensor	O2-BTA		✔

LABQUEST MINI **PHYSIOLOGY** PACKAGE

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ORDER CODE **HP-A** See previous page.

Logger *Pro* 3 software, ORDER CODE **LP**
Buy just one copy—site license for ALL school and students' personal computers is included! See pp. 16–19 for details.

Hand Dynamometer
ORDER CODE **HD-BTA**

Our strain-gage based isometric dynamometer can be used to measure grip strength or finger pinch strength. For more details on this sensor, see page 109.

Spirometer
ORDER CODE **SPR-BTA**

Monitor inspiratory and expiratory air flow and make lung volume measurements. For more details on this sensor, see page 117.

Force Plate
ORDER CODE **FP-BTA**

The Force Plate is a large force sensor—tough enough to jump on. Use it to study balance and biomechanics. For more details on this sensor, see page 108.

1 IT ALL STARTS WITH CURRICULUM

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LabQuest Mini – LabQuest Mini is a low-cost computer solution with five sensor ports. More details on pp. 12–13.

3 CHOOSE YOUR SENSORS

Choose from Vernier's recommended packages or build your own.

Our science department package includes the most frequently used sensors for a variety of science courses to support your entire department.

For a complete list of sensors by subject:

Biology pp. 21–30
Chemistry pp. 31–43
Earth Science pp. 44–49
Environmental Science pp. 56–58
Math pp. 59–61
Middle School pp. 62–63
Physical Science pp. 64–66
Physics pp. 67–79
Water Quality pp. 84–85

4 ADD A COPY OF LOGGER *PRO*

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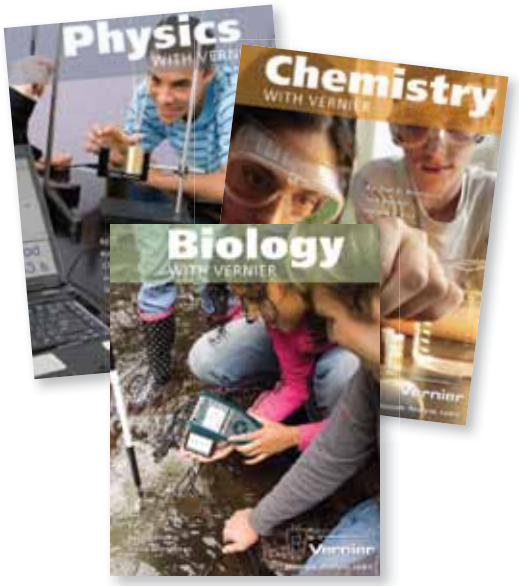

GREAT VALUE

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- Ready-to-use student versions of Logger *Pro* experiments in print; LabQuest, computer, and calculator versions on CD, unless otherwise noted.
- A generous site license. Buy one book and duplicate labs for your class.
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See pp. 86–90 for more information on all of our lab books.

VERNIER LAB BOOKS THAT USE PROBES INCLUDED IN OUR SCIENCE DEPARTMENT PACKAGES

	Stainless Steel Temperature Probe	Light Sensor	Voltage Probe	Motion Detector	Dual-Range Force Sensor	Microphone	Low-g Accelerometer	Magnetic Field Sensor	Gas Pressure Sensor	pH Sensor	Conductivity Probe	Colorimeter	Dissolved Oxygen Probe	CO_2 Gas Sensor	Hand-Grip Heart Rate Monitor
Biology	✔								✔	✔	✔	✔	✔	✔	✔
Chemistry	✔		✔						✔	✔	✔	✔			
Earth Science	✔	✔	✔	✔				✔		✔	✔				
Environmental	✔	✔	✔							✔	✔		✔	✔	
Math	✔	✔	✔	✔	✔	✔			✔	✔					
Middle School	✔	✔	✔	✔	✔			✔	✔	✔	✔				✔
Physical Science	✔	✔	✔	✔	✔			✔	✔	✔	✔				
Physics	✔	✔	✔	✔	✔	✔	✔	✔							
Water Quality	✔									✔	✔	✔	✔		

For more information visit www.vernier.com/probes

Why Use Probeware in Science?

Hands-on science using Vernier technology gets students excited about science and deepens their understanding of complex concepts. It gives students the tools to analyze data and think like real scientists.

Request our **White Paper** by emailing us at **whitepaper@vernier.com**

Science Department LabQuest and LabQuest Mini Packages

Purchase one package per lab group (2–4 students) OR BUILD YOUR OWN PACKAGE from the list of recommended sensors below.

VERNIER LABQUEST

Standalone or Computer

LabQuest Interface & Sensors	CODE	Deluxe Package LQ-SCI-DX
Vernier LabQuest Interface	LABQ	✔
Stainless Steel Temperature Probe	TMP-BTA	✔
Light Sensor	LS-BTA	✔
Voltage Probe	VP-BTA	✔
Motion Detector	MD-BTD	✔
Dual-Range Force Sensor	DFS-BTA	✔
Microphone	MCA-BTA	✔
Low-g Accelerometer	LGA-BTA	✔
Magnetic Field Sensor	MG-BTA	✔
Gas Pressure Sensor	GPS-BTA	✔
pH Sensor	PH-BTA	✔
Conductivity Probe	CON-BTA	✔
Colorimeter	COL-BTA	✔
Dissolved Oxygen Probe	DO-BTA	✔
CO_2 Gas Sensor	CO2-BTA	✔
Hand-Grip Heart Rate Monitor	HGH-BTA	✔

LABQUEST **SCIENCE DEPARTMENT** PACKAGE

You will also need:

Lab books, see pp. 86–90.

Logger *Pro* 3 software, ORDER CODE **LP**
Buy just one copy—site license for ALL school and students' personal computers is included! See pp. 16–19 for details.

VERNIER LABQUEST MINI

Computer Only

LabQuest Mini Interface & Sensors	CODE	Deluxe Package LM-SCI-DX
Vernier LabQuest Mini Interface	LQ-MINI	✔
Stainless Steel Temperature Probe	TMP-BTA	✔
Light Sensor	LS-BTA	✔
Voltage Probe	VP-BTA	✔
Motion Detector	MD-BTD	✔
Dual-Range Force Sensor	DFS-BTA	✔
Microphone	MCA-BTA	✔
Low-g Accelerometer	LGA-BTA	✔
Magnetic Field Sensor	MG-BTA	✔
Gas Pressure Sensor	GPS-BTA	✔
pH Sensor	PH-BTA	✔
Conductivity Probe	CON-BTA	✔
Colorimeter	COL-BTA	✔
Dissolved Oxygen Probe	DO-BTA	✔
CO_2 Gas Sensor	CO2-BTA	✔
Hand-Grip Heart Rate Monitor	HGH-BTA	✔

LABQUEST MINI **SCIENCE DEPARTMENT** PACKAGE

You will also need:

Lab books, see pp. 86–90.

Logger *Pro* 3 software, ORDER CODE **LP**
Buy just one copy—site license for ALL school and students' personal computers is included! See pp. 16–19 for details.

FOR TI CALCULATOR-BASED DATA COLLECTION: see page 94–100

1 IT ALL STARTS WITH CURRICULUM

Want to save time? Start with a Vernier lab book. Aligned to state and national science standards, our lab books contain experiments for LabQuest, computers, and TI graphing calculators.

2 CHOOSE YOUR INTERFACE

Vernier LabQuest – LabQuest is our color, touch-screen interface. Use it as a standalone device or as a computer interface. More details on pp. 5–11.

LabQuest Mini – LabQuest Mini is a low-cost computer solution with five sensor ports. More details on pp. 12–13.

EasyLink – Collect data using a TI-84 graphing calculator. More details on page 94.

3 CHOOSE YOUR SENSORS

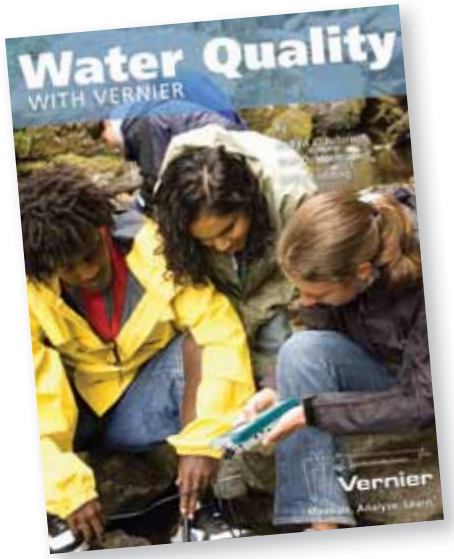
Choose from Vernier's recommended packages or build your own from our list of sensors.

Our Deluxe Package contains all the sensors needed to perform every experiment in our water quality lab book.

Build custom packages online at **www.vernier.com/guide**

4 ADD A COPY OF LOGGER *PRO*

This award-winning software is the best value around! Includes a site license for all computers in your school or your college department, as well as students' personal computers. See pp. 16–19 for details.



GREAT VALUE

Purchase the Lab Book

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WQV

Student Editions Available
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Vernier lab books are loaded with teacher tips, sample graphs, and more. When you buy the lab book you will receive:

- Essential teacher information.
- 16 ready-to-use student versions of Logger *Pro* experiments in print; LabQuest, computer, and calculator versions on CD.
- A generous site license. Buy one book and duplicate labs for your class.
- Easily edit labs to meet your personal teaching style using Microsoft® Word® files for all versions of the experiments on CD.
- Suggested answers, sample data, and graphs.
- Complete equipment and supplies list.

Features listed above are only available when you purchase the lab book. They are not available in the downloadable evaluation PDF.

DOWNLOAD evaluation PDFs for all labs at **www.vernier.com/labs**

Water Quality with Vernier lab book contains the following water quality tests:

☐ ☐ **USING A DISSOLVED OXYGEN SENSOR**
- Dissolved Oxygen
- Biochemical Oxygen Demand

☐ ☐ **USING A TEMPERATURE PROBE**
- Temperature

☐ ☐ **USING A pH SENSOR**
- pH
- Alkalinity

☐ ☐ **USING A TURBIDITY SENSOR**
- Turbidity

☐ ☐ **USING A CONDUCTIVITY PROBE**
- Total Dissolved Solids
- Chloride and Salinity

☐ ☐ **USING A COLORIMETER**
- Phosphates, Ortho- and Total
- Nitrate

☐ ☐ **USING A FLOW RATE SENSOR**
- Flow Rate and Stream Discharge

☐ ☐ **USING ION-SELECTIVE ELECTRODES****
- Nitrate
- Ammonium Nitrogen
- Calcium and Water Hardness
- Chloride and Salinity

WATER TESTS REQUIRING NO SENSOR
- Total Solids
- Fecal Coliform
- Total Water Hardness

WATER-QUALITY INDEX TESTS
- Temperature
- pH
- Turbidity
- Total Solids
- Dissolved Oxygen
- Biochemical Oxygen Demand
- Phosphates, Ortho- and Total
- Fecal Coliform
- Nitrate

☐ STARTER PACKAGES ☐ DELUXE PACKAGES

** Ion-Selective Electrodes require good chemical technique and careful calibration to obtain accurate results. They are not recommended for middle school or elementary students.

AP Many of the experiments in our water quality lab book are the perfect complement to labs for AP* Environmental Science. See **www.vernier.com/ap**

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Use Vernier sensors to collect GLOBE data! The following Vernier sensors meet GLOBE specifications:

- Dissolved Oxygen Probe
- pH Sensor
- Stainless Steel Temperature Probe
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- Relative Humidity Sensor
- Turbidity Sensor
- Salinity Sensor
- Nitrate Ion-Selective Electrode
- Soil Moisture Sensor

To learn more about Vernier and GLOBE, see **www.vernier.com/globe**

Water Quality LabQuest Packages

Purchase one package per lab group (2–4 students) or BUILD YOUR OWN PACKAGE from the list of recommended sensors below.

Standalone or Computer

LabQuest Interface & Sensors	CODE	Starter Package LQ-WQ-STR	Deluxe Package LQ-WQ-DLX
Vernier LabQuest Interface	LABQ	✔	✔
Stainless Steel Temperature Probe	TMP-BTA	✔	✔
pH Sensor	PH-BTA	✔	✔
Dissolved Oxygen Sensor	DO-BTA	✔	✔
Conductivity Probe	CON-BTA	✔	✔
Turbidity Sensor	TRB-BTA	✔	✔
Vernier GPS Sensor	VGPS	✔	✔
Colorimeter	COL-BTA		✔
Flow Rate Sensor	FLO-BTA		✔
Nitrate Ion-Selective Electrode	NO3-BTA		✔
Calcium Ion-Selective Electrode	CA-BTA		✔
Chloride Ion-Selective Electrode	CL-BTA		✔
Ammonium Ion-Selective Electrode	NH4-BTA		✔
LABQUEST	**WATER QUALITY** PACKAGE		

You will also need:

Water Quality with Vernier **lab book,** ORDER CODE **WQV**
See previous page.

Logger *Pro* 3 software, ORDER CODE **LP**
Buy just one copy—site license for ALL school and students' personal computers is included! See pp. 16–19 for details.

More Products for Water Quality Testing

Salinity Sensor, ORDER CODE **SAL-BTA**
For measuring TDS or salinity in sea or brackish water

Extra-Long Temperature Probe
ORDER CODE **TPL-BTA**
30-meter cable to measure at depth

Water Depth Sampler, ORDER CODE **WDS**
To collect samples from as deep as 15 meters

LabQuest Lanyard, ORDER CODE **LQ-LAN**
To secure LabQuest around students' necks

Vernier EasyLink, ORDER CODE **EZ-LINK**
For use with TI calculators

Collecting water quality data with TI graphing calculators? See www.vernier.com/easylink

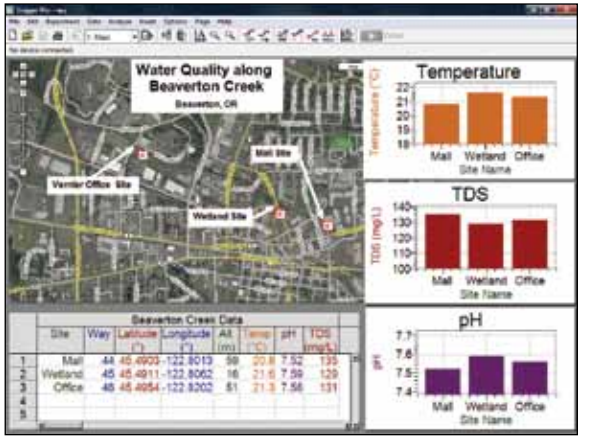
ORDER CODE
VGPS

Vernier GPS Sensor

The Vernier GPS (Global Positioning System) Sensor collects location data such as latitude, longitude, and altitude right on your LabQuest or computer.

- Record your location as you measure water quality at various sites along a stream.
- Data (sensor and GPS) can be exported to GIS software or Google Maps.

See page 108 for more information

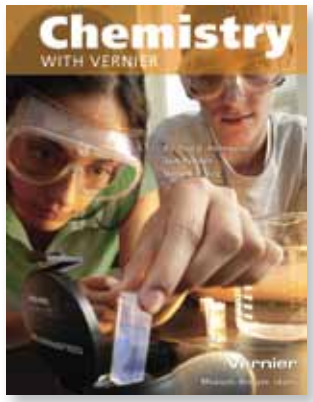


Use Logger Pro *to map GPS data and water quality sensor data.*

Enhance Your Curriculum with Vernier Lab Books

Buy just one copy per classroom, photocopy the labs, or print them from the included CD.

Each book includes a CD with word-processing files of the student instructions for data collection using Logger *Pro* (computer), LabQuest App (LabQuest as a standalone device), and EasyData and DataMate (TI graphing calculators), unless otherwise noted.



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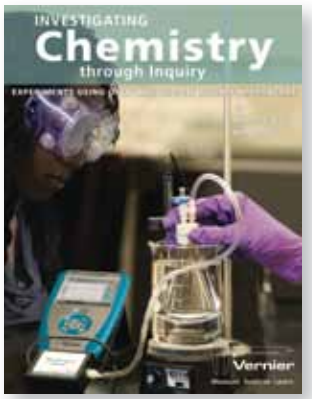

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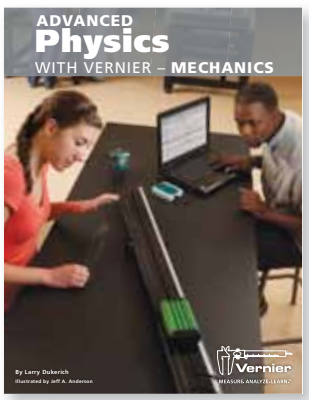

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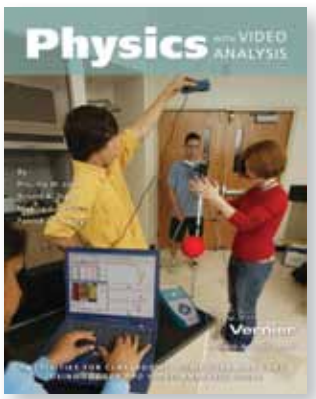

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a. *Chemistry with Vernier,* ORDER CODE **CWV**
Highly recommended for first-year chemistry.
This book contains 36 experiments in thermochemistry, gas laws, acid-base reactions, equilibrium, electrochemistry, electrolytes, states of matter, and more. See page 32.

b. *Advanced Chemistry with Vernier,* ORDER CODE **CHEM-A**
Highly recommended for second-year or advanced chemistry.
This book contains 35 advanced chemistry experiments designed for use with Vernier probeware. The first 22 experiments have a 1-to-1 correlation with the 22 experiments recommended by AP for AP* Chemistry courses. See page 34.

c. *Investigating Chemistry through Inquiry,* ORDER CODE **CHEM-I**
Great resource for those teaching inquiry-based chemistry.
This book contains 25 inquiry-based chemistry investigations. It includes topics such as thermochemistry, acids and bases, stoichiometry, chemical kinetics, and properties of solutions. See page 36.

d. *Physics with Vernier,* ORDER CODE **PWV**
Highly recommended for first-year physics or advanced physics.
This book contains 35 experiments in mechanics, sound, light, electricity, and magnetism. See page 68.

e. NEW *Advanced Physics with Vernier – Mechanics*
ORDER CODE **PHYS-AM**
This is the first of a two-volume set of experiments for the more in-depth introductory physics course, such as college physics, AP* Physics, or IB† Physics. Experiments are designed for an interactive teaching style. See page 70.

f. *Physics with Video Analysis,* ORDER CODE **PVA**
The *Physics with Video Analysis* book contains a wide selection of video analysis activities using Logger *Pro* for introductory physics. Topics include kinematics, dynamics, circuits, sound, electrostatics, and more. Includes a CD with professionally made videos, student activities, solutions, and Logger *Pro* setup files. See page 78.

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†The IB Diploma Program is an official program of the International Baccalaureate Organization (IBO) which authorizes schools to offer it. The material available here has been developed independently of the IBO and is not endorsed by it.

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FREE evaluation labs available at **www.vernier.com/labs**

Did you know?

You can customize the lab instructions on your LabQuest using My LabQuest Library. See page 9 for details.

a. *Biology with Vernier,* ORDER CODE **BWV**

Highly recommended for first-year biology.

This book contains 31 experiments in cell respiration, photosynthesis, membrane diffusion, osmosis, human physiology, transpiration, fermentation, and other important biology concepts. See page 22.

b. *Advanced Biology with Vernier,* ORDER CODE **BIO-A**

Highly recommended for second-year or advanced biology.

This new book contains all 12 recommended AP* Biology labs. Additional advanced-level labs make it appropriate for introductory college biology courses, as well. See page 24.

c. *Human Physiology with Vernier,* ORDER CODE **HP-A**

This book, for data collection on computers and LabQuest only, contains 24 human physiology experiments. The experiments are designed to encourage students to think about the physiology of various human organ systems. See page 80.

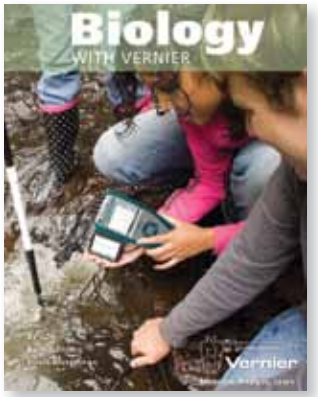
d. *Investigating Environmental Science through Inquiry,* ORDER CODE **ESI**

Highly recommended for those teaching inquiry-based environmental science.

This book contains 34 inquiry-based investigations. It covers issues that prompt students' interest in the effects of man-made environmental changes. Includes correlations for AP* and IB† environmental science. Student labs are not platform specific. See page 56.

e. *Water Quality with Vernier,* ORDER CODE **WQV**

This book contains 16 water quality tests, including pH, total dissolved solids, dissolved oxygen, BOD, flow rate, turbidity, nitrates, and phosphates. All nine tests in the Water Quality Index (WQI) are supported. See page 84.



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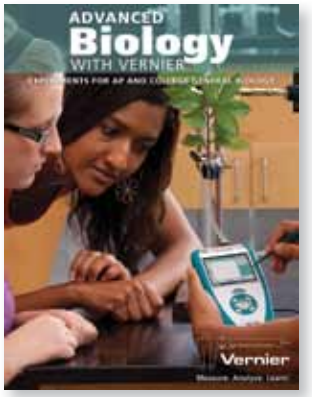

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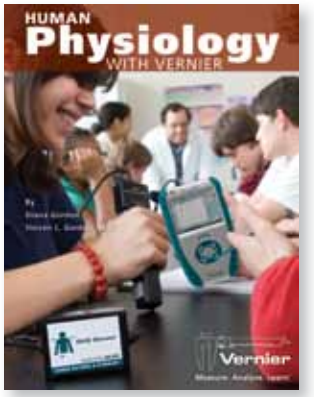

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Student Editions of our Lab Books

Have you always wanted your students to have their own copies of our lab books? Our most popular lab books are now available as student editions. These print-on-demand lab books include:

- Student pages for all experiments in the corresponding Teacher Editions
- Table of contents
- Sensor chart
- Your choice of printed Logger *Pro* (computer) or LabQuest App (LabQuest standalone) instructions
- Coil bound

The following student editions are available:

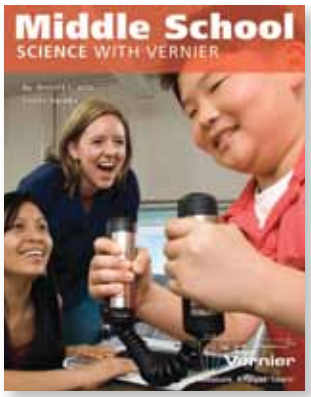
Advanced Biology with Vernier - Logger *Pro*, **BIOA-S-LP**
Advanced Biology with Vernier - LabQuest App, **BIOA-S-LQ**
Biology with Vernier - Logger *Pro*, **BWV-S-LP**
Biology with Vernier - LabQuest App, **BWV-S-LQ**
Advanced Chemistry with Vernier - Logger *Pro*, **CHEMA-S-LP**
Advanced Chemistry with Vernier - LabQuest App, **CHEMA-S-LQ**
Chemistry with Vernier - Logger *Pro*, **CWV-S-LP**
Chemistry with Vernier - LabQuest App, **CWV-S-LQ**
Human Physiology with Vernier - Logger *Pro*, **HPA-S-LP**
Human Physiology with Vernier - LabQuest App, **HPA-S-LQ**
Advanced Physics with Vernier - Mechanics, **PHYS-AM-S**
Physics with Vernier - Logger *Pro*, **PWV-S-LP**
Physics with Vernier - LabQuest App, **PWV-S-LQ**
Water Quality with Vernier - Logger *Pro*, **WQV-S-LP**
Water Quality with Vernier - LabQuest App, **WQV-S-LQ**

Don't see your favorite lab book listed? Contact us for availability.

Please allow for additional processing time when ordering.

See www.vernier.com/books for more information.

5 book minimum order per title



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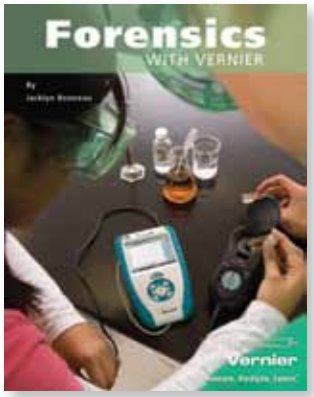

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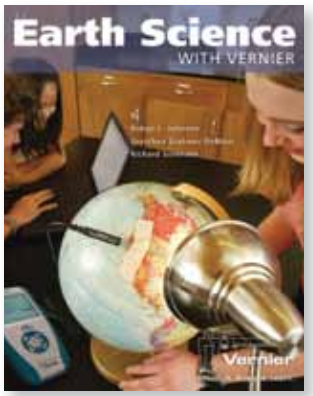

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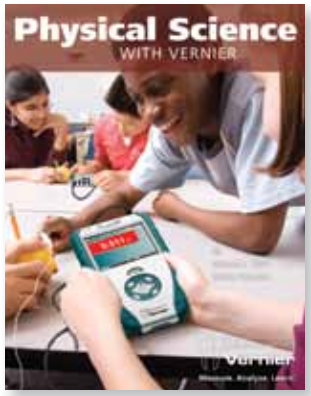

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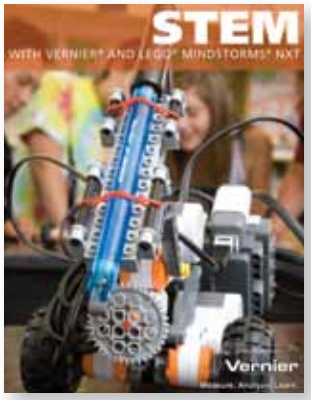

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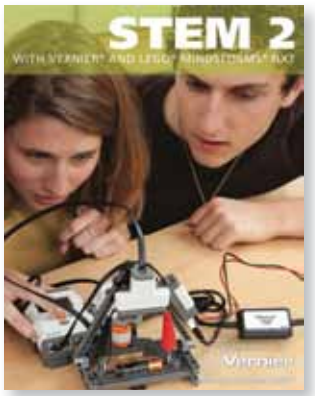

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Helping You Meet Content Standards

Vernier understands that meeting curriculum standards is an important part of today's teaching. As state and federal requirements change, we are committed to providing you with the most current information. You will find the following alignments to standards on our web site, **www.vernier.com/standards**, for all lab books published by Vernier:

- Science standards for all 50 U.S. states
- Provincial standards for Canada
- NCTM (National Council for Teachers of Mathematics)
- AP and IB
- NSES (National Science Education Standards)
- ISTE (International Society for Technology Educators)

a. *Middle School Science with Vernier,* ORDER CODE **MSV**

This book is written specifically for students in grades 6–8. It contains 38 experiments in Earth science, life science, and physical science. See page 62 for more information.

b. *Forensics with Vernier,* ORDER CODE **FWV**

This book is for teachers at the high school level who wish to introduce their students to forensics using engaging and realistic laboratory activities with Vernier probeware. The book contains 14 lab activities dealing with various aspects of forensic science.

c. *Earth Science with Vernier,* ORDER CODE **ESV**

This book contains 33 experiments and six projects. Topics include geology, soil analysis, water quality, hydrology, oceanography, meteorology, and energy. See page 44 for more information.

d. *Physical Science with Vernier,* ORDER CODE **PSV**

This book contains 40 experiments for physical science (middle school through grade 10). These experiments are perfect for introductory physical science and integrated science classes. See page 64 for more information.

e. *STEM with Vernier® and LEGO® MINDSTORMS® NXT*
ORDER CODE **STEM**

This book includes 14 environmental lab activities and 4 design-and-build robotics projects using pH, Conductivity, UV, and Soil Moisture Sensors coupled with the LEGO MINDSTORMS NXT intelligent interface. Includes a CD with MINDSTORMS NXT sample programs, movie clips, and LEGO Digital Designer files. See page 49 for more information.

f. *STEM 2 with Vernier® and LEGO® MINDSTORMS® NXT*
ORDER CODE **STEM2**

This is our second book of projects and activities for engineering eduction and includes 12 lab activities and 8 design-and-build robotics projects. It covers topics in physical science and engineering, including mechanics, pressure, electricity, and magnetism. Includes a CD with MINDSTORMS NXT sample programs, movie clips, and LEGO Digital Designer files. See page 48 for more information.

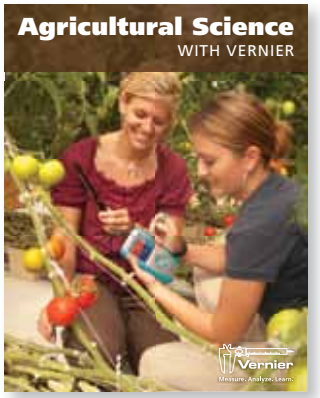
a. NEW *Agricultural Science with Vernier,* ORDER CODE **AWV**

This new lab book contains experiments specifically chosen for teaching topics in agricultural science at the high school or college level. Experiments range from the investigation of factors affecting transpiration, to the temperature effect shearing has on sheep, to the development of an understanding of Ohm's law. You can view the entire table of contents and see packages at www.vernier.com/agricultural

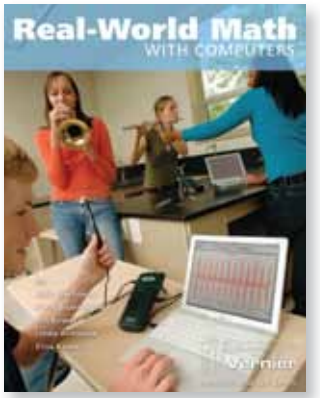
b. *Real-World Math with Computers,* ORDER CODE **RWC-LP**

c. *Real World Math Made Easy,* ORDER CODE **RWCALC**

These manuals contain 29 or more activities that explore real-world applications of math concepts from algebra through calculus. Activities cover topics such as linear, quadratic, and periodic functions, statistics, systems of equations, and many more.



(a) NEW



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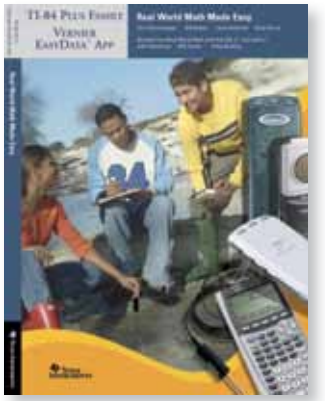

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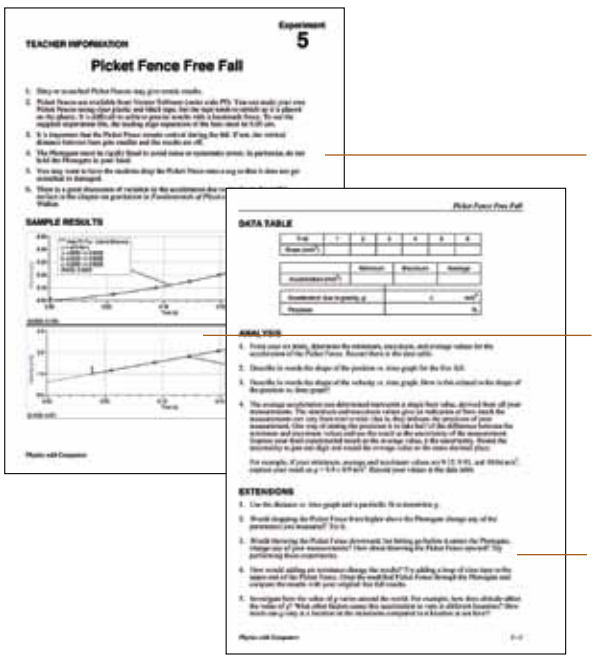
***CD includes easy-to-edit Word files** for the student experiments, and instructions for LabQuest, computers, and calculators.*

Lab Book Features

From Physics with Vernier *lab book*



Preliminary questions promote inquiry-based experiments

Procedures give ***detailed instructions***

Detailed teacher information *helps experiments run smoothly*

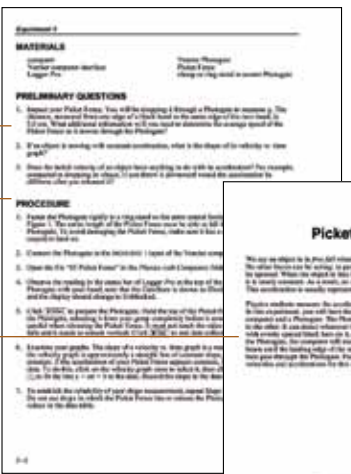
Background information *reinforces the scientific concepts behind the experiment and helps enrich the laboratory experience*

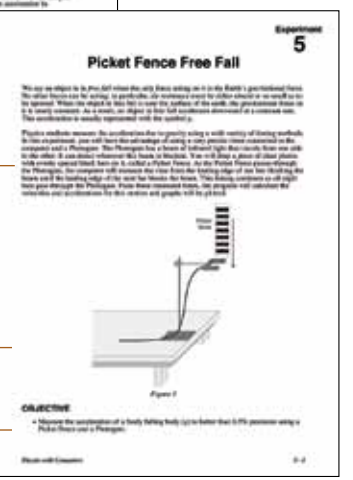
Sample data and graphs *let instructors see expected results*

Clear illustrations *help students visualize the experiment*

Concise objectives *specify desired student performance*

Extensions *provide suggestions for further investigation*





MORE ONLINE
FREE evaluation labs available at www.vernier.com/labs

GREAT VALUE

Vernier lab books are loaded with teacher tips, sample graphs, and more. When you buy the lab book, you will receive:

- Essential teacher information.
- Ready-to-use student versions of Logger *Pro* experiments in print; LabQuest, LabQuest Mini, computer, and calculator versions on CD, unless otherwise noted.
- A generous site license. Buy one book and duplicate labs for your class.
- Easily edit labs to meet your personal teaching style using Microsoft® Word® files for all versions of the experiments on CD.
- Suggested answers, sample data, and graphs.
- Complete equipment and supplies list.

Features listed above are only available when you purchase the lab book. They are not available in the downloadable evaluation PDFs.

DOWNLOAD evaluation PDFs for all labs at **www.vernier.com/labs**

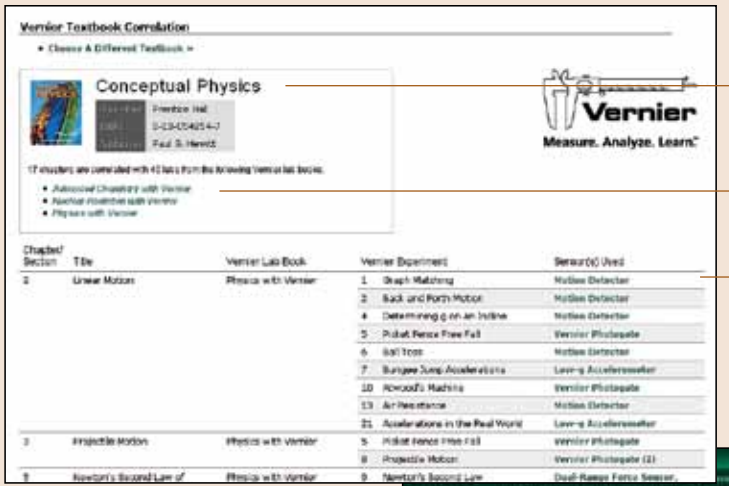
TRAINING VIDEOS ONLINE
Watch training videos and download free activities at
www.vernier.com/videos

Vernier Textbook Correlations

Vernier lab activities are matched to the tables of contents in dozens of popular textbooks. Check out the Vernier textbook correlations to see how easy it is for you to integrate technology into your curriculum.

MORE ONLINE
www.vernier.com/publishers

Integrate Technology into Your Curriculum



View specific textbook information

Easily identify correlated Vernier lab books

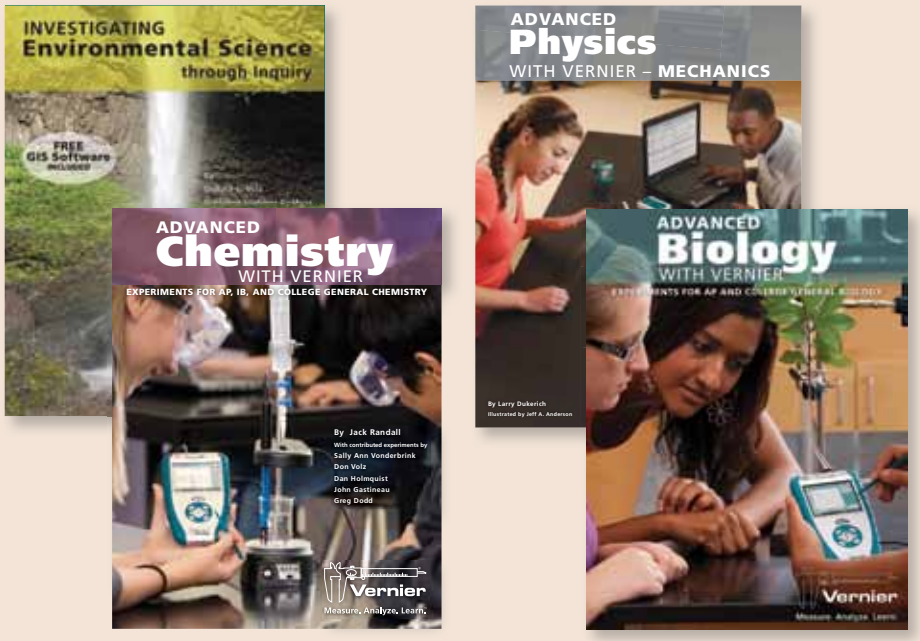
Detailed correlation report includes your textbook's chapter number and title, along with the correlated Vernier experiment title and sensor used.

Many popular science textbooks have already been correlated.

Browse correlated textbooks by subject area or publisher name

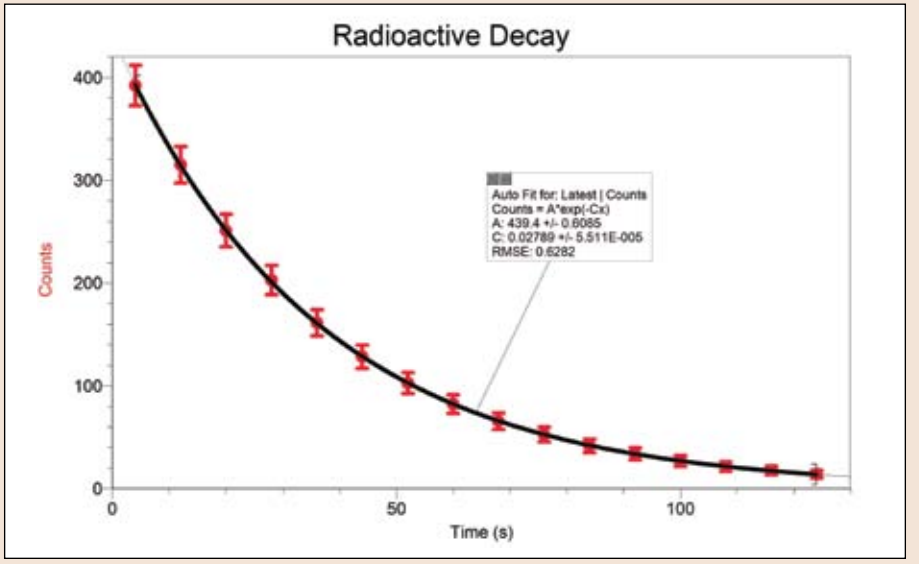
Your Complete Solution for AP* and IB† Science

Curriculum



- Correlations to AP and IB standards for biology, chemistry, physics, and environmental science
- Editable Word files for all student pages, so you can customize the labs to meet your standards
- ICT support for the IB group 4 sciences
- Questions promote higher-order thinking skills
- Lab extensions encourage inquiry investigations

Software



Logger *Pro* 3, ORDER CODE **LP,** One CD for Mac OS X and Windows

- Manual configuration mode allows students to set all data-collection parameters
- Error bars
- Log and semi-log graphs
- Modeling
- Custom curve fits
- Double y-graphs
- Gel analysis
- Peak integration on GC data
- Export data to Google Maps or GIS
- Spectrometer data analysis

See pp. 16–19 for details.

New IB† Standards All IB Group 4 experimental science courses now require students to use sensors for data logging in an experiment and software for graph plotting. For IB correlations, visit www.vernier.com/ib

Additional information on data-collection packages for AP and IB science can be found on the following pages:

Advanced Biology – pp. 24–25
Advanced Chemistry – pp. 34–35
Advanced Physics – pp. 70–71
Environmental Science – pp. 56–57

*AP and Advanced Placement Program are registered trademarks of the College Entrance Examination Board, which was not involved in the production of and does not endorse this product.

†The IB Diploma Program is an official program of the International Baccalaureate Organization (IBO) which authorizes schools to offer it. The material available here has been developed independently of the IBO and is not endorsed by it.

Versatile Solution for Calculator and Computer Data Collection

ORDER CODE
LABPRO

Three different ways to collect data! You can use LabPro with a computer, Texas Instruments graphing calculator, or on its own as a remote data collector.

- Multi-channel interface
- **59 Vernier sensors** can be connected to the LabPro
- Six data-collection channels allow you to use multiple sensors at once
- Samples up to 50,000 readings per second

Included with LabPro: LabPro unit, power adapter, USB computer cable, calculator cable, calculator cradle, DataMate calculator program, user's manual, voltage probe

AAPT
Most Innovative
New Product Award

For more information on curricular materials and sensors appropriate for your subject area, see:

Biology	21–30
Chemistry	31–43
Earth Science	44–47
Environmental Science	56–58
Math	59–61
Middle School	62–63
Physical Science	64–66
Physics	67–79
Physiology	80–81
Science Department	82–83
Water Quality	84–85

LabPro Features

COMPATIBILITY
- Windows or Macintosh computers via USB with Logger *Pro* software
- TI graphing calculators:
  All current TI graphing calculators except TI-Nspire and TI-Nspire CAS

SIX DATA-COLLECTION CHANNELS
- Four channels for 53 different sensors, including temperature, dissolved oxygen, gas pressure, pH, force, and more
- Two channels for motion detectors, photogates, radiation monitor, rotary motion sensor, drop counter, and digital control unit.

SENSOR COMPATIBILITY
- Supports our auto-ID sensors or can be used with our older sensors using the appropriate adapters.

UPGRADEABLE
- LabPro's flash memory means that new features can easily be added as they become available. Simply download and install the new operating system from our web site…**FREE!**

SAMPLING
- Samples up to 50,000 readings per second
- 12-bit A/D conversion
- Internally stores 12,000 data points

DIGITAL LINES
- 8 TTL input/output lines
  (4 on each DIG/SONIC port)

ANALOG OUTPUT
- 1 channel, ±4 volts, 100 mA
  (with function generator)

Collecting and analyzing sound data using a TI-84 running EasyData, a LabPro, and a microphone.

A diprotic pH titration using a LabPro, pH sensor, Vernier drop counter, and a Vernier stir station.

LABPRO COMPATIBLE SENSORS

SENSOR	CODE
Accelerometers	
3-Axis Accelerometer	3D-BTA
25-g Accelerometer	ACC-BTA
Low-g Accelerometer	LGA-BTA
NEW Anemometer	ANM-BTA
Barometer	BAR-BTA
Blood Pressure Sensor *	BPS-BTA
Charge Sensor	CRG-BTA
CO_2 Gas Sensor	CO2-BTA
Colorimeter	COL-BTA
Conductivity Probe	CON-BTA
Current Probes	
Current Probe	DCP-BTA
NEW High Current Sensor	HCS-BTA
Digital Control Unit †	DCU-BTD
Dissolved Oxygen Probe	DO-BTA
Drop Counter †	VDC-BTD
Dual-Range Force Sensor	DFS-BTA
EKG Sensor	EKG-BTA
Electrode Amplifier	EA-BTA
Flow Rate Sensor	FLO-BTA
Force Plate	FP-BTA

SENSOR	CODE
Gas Pressure Sensor	GPS-BTA
Hand Dynamometer	HD-BTA
Hand-Grip Heart Rate Monitor	HGH-BTA
Instrumentation Amplifier	INA-BTA
Ion-Selective Electrodes	
Ammonium Ion-Selective Electrode	NH4-BTA
Calcium Ion-Selective Electrode	CA-BTA
Chloride Ion-Selective Electrode	CL-BTA
Nitrate Ion-Selective Electrode	NO3-BTA
Light Sensor	LS-BTA
Magnetic Field Sensor	MG-BTA
NEW Melt Station	MLT-BTA
Microphone	MCA-BTA
Motion Detector	MD-BTD
O_2 Gas Sensor	O2-BTA
ORP Sensor	ORP-BTA
pH Sensor	PH-BTA
Tris-Compatible Flat pH Sensor	FPH-BTA
Photogate †	VPG-BTD
Power Amplifier †	PAMP
Radiation Monitor † (Digital)	DRM-BTD

SENSOR	CODE
Relative Humidity Sensor	RH-BTA
Respiration Monitor Belt *(requires GPS-BTA)*	RMB
Rotary Motion Sensor †	RMV-BTD
Salinity Sensor	SAL-BTA
Soil Moisture Sensor	SMS-BTA
Sound Level Meter	SLM-BTA
Spirometer	SPR-BTA
Temperature Probes	
Extra-Long Temperature Probe	TPL-BTA
Infrared Thermometer	IRT-BTA
Stainless Steel Temperature Probe	TMP-BTA
Surface Temperature Sensor	STS-BTA
Thermocouple	TCA-BTA
Wide-Range Temperature Probe *	WRT-BTA
Turbidity Sensor	TRB-BTA
UVA Sensor	UVA-BTA
UVB Sensor	UVB-BTA
Voltage Probes	
Differential Voltage Probe	DVP-BTA
Voltage Probe	VP-BTA
NEW 30-Volt Voltage Probe*	30V-BTA

* Not supported with TI calculators † Not supported with Logger Lite software

Interfaces

We offer several options for data collection for different budgets and classroom setups.
To help you decide which interface is right for you, we've included brief descriptions of each interface and an overview comparison chart to distinguish their strengths.

VERNIER LabPro®

ORDER CODE
LABPRO

The Vernier LabPro Interface is our full-featured, data-collection interface offering everything that you need for data collection with a TI graphing calculator.

LabPro can also be connected to a computer for additional data collection options.

For LabPro sensor packages go to **www.vernier.com/pkgs**

TEXAS INSTRUMENTS CBL 2

ORDER CODE
CBL2

The CBL 2 is an easy-to-use, powerful, and inexpensive data-collection tool. The CBL 2 System includes the CBL 2 interface, a Stainless Steel Temperature Probe, TI Light Probe, Voltage Probe, calculator cradle, link cable, batteries, user's guide, and a TI resource CD.

Over 50 Vernier sensors can be connected to the CBL 2.
For CBL 2 sensor packages go to **www.vernier.com/pkgs**

VERNIER EasyLink®

ORDER CODE
EZ-LINK

With the Vernier EasyLink, data collection with a TI graphing calculator is easier and more affordable.

EasyLink is a single-channel interface that plugs into the USB port of a TI-84 graphing calculator or TI-Nspire Handheld. It supports any one of **45 Vernier sensors**.

EasyLink is an affordable way to get started with calculator-based data collection!

WHAT INTERFACE IS RIGHT FOR ME?

	LabPro	CBL 2	EasyLink
Calculator Compatibility	All TI graphing calculators except the TI-82, TI-85, and TI-Nspire	All TI graphing calculators except the TI-82, TI-85, and TI-Nspire	TI-84 Plus, TI-84 Plus Silver Edition, TI-Npsire, and TI-Nspire CAS
Channels	4 analog and 2 digital/sonic	3 analog and 1 digital/sonic	1 analog
Number of compatible sensors (See page 101 for a complete list.)	59 sensors *(55 with Calculators)*	54 sensors	45 sensors
Use with Motion Detectors, Photogates	Yes	Yes	No *(For motion, CBR 2 can be purchased separately)*
Use with Microphones	Yes	Yes	No
Maximum Sample Rate	50,000	50,000	200
Included sensors	Voltage	Voltage, Light, Temperature	None
Compatible with Logger *Pro* software on a computer	Yes	No	Yes *(with a separate adapter)* ORDER CODE MINI-USB

TI Graphing Calculators

TI graphing calculators are valuable tools in math and science. For middle school, we recommend the TI-73 Explorer or TI-84 Plus family of calculators. For high school, we recommend the TI-84 or the TI-Nspire (see page 96) family of calculators. These calculators can be purchased individually or in convenient teacher packs of 10 calculators.

TI-84 Plus Silver Edition

ORDER CODE **TI-84PSE**

Recommended for High School. It comes with a USB port for data collection with our Easy products and for connectivity to a computer.

- More than 20 pre-loaded Apps, including EasyData, Cabri™ Jr., and Periodic Table
- 2.5 times the memory and 9 times the memory of the TI-83 Plus

TI-84 Plus

ORDER CODE **TI-84PL**

Recommended for High School. A lower cost alternative to the TI-84 Plus Silver Edition. It comes with a USB port for data collection with our Easy products and for connectivity to a computer.

- Over ten pre-loaded Apps including EasyData and Cabri™ Jr.
- 2.5 times the speed and 3 times the memory of the TI-83 Plus

Teacher Packs for the TI-84 Plus

Teacher packs for the TI-84 Plus and TI-84 Plus Silver Edition calculators are available. Each teacher pack includes 10 calculators, 40 batteries, 5 unit-to-unit USB cables, 5 computer USB cables, a calculator poster and transparency, and a manual. These calculators have a bright yellow back and slide case and the words "School Property" on the front of the calculator.

TI-84 EZ Spot Teacher Pack

ORDER CODE **TI-84SPOTTP**

TI-84 Plus Silver Edition EZ Spot Teacher Pack

ORDER CODE **TI-84SESPTP**

TI-83 Plus Graphing Calculator

ORDER CODE **TI-83PL**

Low-cost choice for use in high school science and math courses. The TI-83 Plus contains Flash ROM technology.

TI-83 Plus Teacher Pack

ORDER CODE **TI-83PLTP**

A teacher pack for the TI-83 Plus calculator is available. Each teacher pack includes 10 calculators, 40 batteries, 5 unit-to-unit cables, a USB TI-Connectivity cable, a calculator poster and transparency, and a manual.

TI-73 Explorer Graphing Calculator

ORDER CODE **TI-73EX**

Recommended for Middle School. A simple keypad makes it easier for younger students to use. The TI-73 Explorer is electronically upgradable.

TI-73 Explorer Teacher Pack

ORDER CODE **TI-73EXTP**

A teacher pack for the TI-73 Explorer calculator is available. Each teacher pack includes 10 calculators, 40 batteries, 5 unit-to-unit cables, a USB TI-Connectivity cable, a calculator poster and transparency, and a manual.

Check out our Easy products for TI-84 Plus calculators and TI-Nspire handhelds. See pp. 99.

MORE ONLINE

For more information on real-world data with a calculator go to www.vernier.com/calc

TI-Nspire™ Technology for Math and Science

The TI-Nspire product line includes handhelds and software that provide teachers with flexibility and versatility to meet different needs in math and science classrooms. These learning tools allow students to:

- See algebraic, graphical, geometric, numeric, and written representations.
- Link different representations of a problem.
- Use built-in interactive geometry.
- Enter and review expressions and formulas as seen in a textbook.
- Explore topics from algebra to calculus.
- Collect real-world data with Vernier sensors.

Two different handhelds, TI-Nspire and TI-Nspire CAS, are available.

The TI-Nspire CAS handheld includes built-in CAS (Computer Algebra System) capabilities, which enables students to explore and manipulate mathematical expressions in symbolic form.

Computer versions of TI-Nspire software and TI-Nspire CAS software are also available.

Save $$ with multi-user software licenses!
Go to **www.vernier.com/ti-nspire-licenses**

TI-Nspire Products

TI-Nspire Touchpad Handheld, ORDER CODE **TI-NS2**
Includes TI-Nspire handheld and 4-AAA batteries.

TI-Nspire Touchpad Teacher Bundle, ORDER CODE **TI-NS2-TB**
Includes TI-Nspire Handheld, 4-AAA batteries, and a single license of TI-Nspire Teacher Edition software.

TI-Nspire Touchpad Teacher Pack, ORDER CODE **TI-NS2-TPK**
Includes 10 TI-Nspire EZ Spot handhelds with the words "School Property" on the keypad and 40-AAA batteries.

TI-Nspire Computer Software – single user license
TI-Nspire computer software and the TI-Nspire learning handheld share the same set of functionality, so you and your class can use either as a standalone learning tool.

Student Software, ORDER CODE **TI-NSSW-1**
Teacher Software, ORDER CODE **TI-NST-SP-KT**
Teacher software includes built-in SmartView Emulator.

TI-Nspire CAS Products

TI-Nspire CAS Touchpad Handheld, ORDER CODE **TI-NSCAS2**
Includes a TI-Nspire CAS handheld and 4-AAA batteries.

TI-Nspire CAS Touchpad Teacher Bundle
ORDER CODE **TI-NSCAS2-TB**
Includes TI-Nspire CAS handheld, 4-AAA batteries, and a single license of TI-Nspire CAS Teacher Edition software.

TI-Nspire CAS Touchpad Teacher Pack
ORDER CODE **TI-NSCAS2-TPK**
Includes 10 TI-Nspire CAS handhelds and 40-AAA batteries.

TI-Nspire CAS Computer Software – single user license
TI-Nspire CAS Computer Software is designed for Algebra through Calculus. It contains Computer Algebra System functionality.

Student Software, ORDER CODE **TI-NSCASSW-1**
Teacher Software, ORDER CODE **TI-NSCT-SP-KT**
Teacher software includes built-in SmartView Emulator.

TI-Nspire Rechargeable Battery, ORDER CODE **TI-NS2-BAT**
Use this lithium-ion rechargeable battery with your TI-Nspire or TI-Nspire CAS Touchpad handheld. Includes a single battery and wall adapter.

Not compatible with original TI-Nspire or TI-Nspire CAS Clickpad handhelds.

ORDER CODE
TI-NS2

ORDER CODE
TI-NSCAS2

ORDER CODE
TI-NS2-BAT

NEW Data Collection with TI-Nspire™ Technology

Vernier and Texas Instruments have teamed up once again, this time to provide a full-featured, data-collection solution for TI-Nspire technology. It starts with the Vernier DataQuest Application, a built-in App found in the TI-Nspire 3.0 handheld and computer software*. Now add the TI-Nspire Lab Cradle, a multi-channel sensor interface that supports 58 Vernier sensors. Use this powerful combination to bring real-world data to your science and math classroom.

NEW TI-Nspire™ Lab Cradle, ORDER CODE TI-NSLABC

The TI-Nspire Lab Cradle is a multi-channeled data-collection interface for use with TI-Nspire technology (sold separately). The Lab Cradle has five sensor ports for use with 58 Vernier sensors. (For a complete list of supported sensors, go to www.vernier.com/ti-nspire.) Collect data up to 100,000 samples per second. The Lab Cradle is compatible with TI-Nspire computer software and handhelds running software version 3.0 or newer. The Lab Cradle includes a rechargeable battery and AC Adaptor.

NEW TI-Nspire™ Lab Cradle Bundle, ORDER CODE TI-NSLABC-5

Includes 5 TI-Nspire Lab Cradles with rechargeable batteries, and a 5-unit charging bay.

Introducing the DataQuest™ Application from Vernier

The DataQuest App is our full-featured data-collection and analysis application for TI-Nspire technology. DataQuest supports data collection, graph and tabular representation, and data analysis—all in a single TI-Nspire application. When used with the New TI-Nspire Lab Cradle sensor interface, DataQuest supports 58 Vernier sensors.

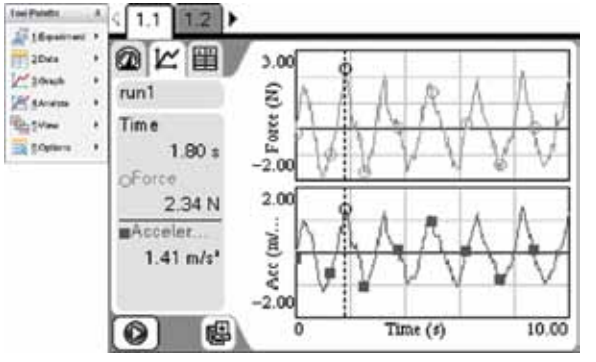
Key Features

- Meter, Graph, and Table views—all in the same application
- Supports NEW TI-Nspire™ Lab Cradle, EasyLink, and Go!Link sensor interfaces
- Supports EasyTemp, Go!Temp, CBR 2, and Go!Motion
- Collect data with 58 Vernier sensors
- Manually enter data for analysis of non sensor-based data
- Analysis features:
  - Curve fitting: 11 fits, including proportional and natural exponent
  - User-defined modeling
  - Tangent, integral, statistics
  - Draw predictions
  - Position and velocity motion matching
- Advanced options:
  - Sensor calibration
  - Offline sensor setup including legacy, non-auto ID sensors
  - Multi-channel, triggered, and remote data collection with TI-Nspire Lab Cradle
  - Meter and graph display of user-defined columns
  - Replay data collection
  - Live sensor values available for use in other TI-Nspire Apps
- Included free with TI-Nspire software*, version 3.0 or newer

*The TI-Nspire software is a free upgrade to all existing TI-Nspire users.

AVAILABLE APRIL 2011

ORDER CODE
TI-NSLABC



TI-Nspire Data Collection Packages (available April 2011)

Purchase one package per lab group (2–4 students) OR BUILD YOUR OWN PACKAGE from the list of recommended sensors below.

TI-Nspire Handhelds or Computer Software

Interface and Sensors	CODE	Starter Package LC-SCI-ST	Deluxe Package LC-SCI-DX
TI-Nspire Lab Cradle	TI-NSLABC	✔	✔
Stainless Steel Temperature Probe	TMP-BTA	✔	✔
Motion Detector	MD-BTA	✔	✔
Conductivity Probe	CON-BTA	✔	✔
pH Sensor	PH-BTA	✔	✔
Gas Pressure Sensor	GPS-BTA	✔	✔
Magnetic Field Sensor	MG-BTA	✔	✔
Dual-Range Force Sensor	DFS-BTA	✔	✔
Microphone	MCA-BTA	✔	✔
Hand-Grip Heart Rate Monitor	HGH-BTA	✔	✔
Dissolved Oxygen Probe	DO-BTA		✔
Colorimeter	COL-BTA		✔
Low-g Accelerometer	LGA-BTA		✔
CO_2 Gas Sensor	CO2-BTA		✔
Light Sensor	LS-BTA		✔
Differential Voltage Probe	DVP-BTA		✔
Save when you purchase sets of 5 (includes Lab Cradle Bundle)		**LC-SCI-ST5**	**LC-SCI-DX5**

You will also need:

Science with TI-Nspire Technology

See below. ORDER CODE **SWN**

TI-Nspire Handheld or Computer Software

See page 96.

NEW *Science with TI-Nspire™ Technology* Available April 2011

ORDER CODE **SWN**

This book is written for students doing data collection with TI-Nspire handhelds and software. It contains 33 experiments in Earth/environmental science, biology, chemistry, and physics.

TEMPERATURE PROBE
- Intro to Data Collection
- Soil Temperature*
- Water Quality
- Reflection and Absorption of Light*†
- Dew Point
- Seasons and Angle of Insolation
- Freezing and Melting of Water
- Evaporation and Intermolecular Attractions
- Hess's Law

MOTION DETECTOR
- Graph Matching
- Ball Toss
- Static and Kinetic Friction*
- Simple Harmonic Motion

CONDUCTIVITY PROBE
- Water Quality
- Diffusion through Membranes
- Conducting Solutions
- Properties of Solutions
- Conductivity of Solutions

pH SENSOR
- Water Quality
- Acids and Bases
- Interdependence of Plants and Animals*†
- Acid Rain

GAS PRESSURE SENSOR
- Enzyme Action
- Transpiration
- Boyle's Law

MAGNETIC FIELD SENSOR
- Exploring Magnetism
- Where Is North?

DUAL-RANGE FORCE SENSOR
- Newton's Second Law*†
- Static and Kinetic Friction*

MICROPHONE SENSOR
- Sound Waves and Beats
- Speed of Sound

HAND-GRIP HEART RATE MONITOR
- Heart Rate and Physical Fitness
- Ventilation and Heart Rate

DISSOLVED OXYGEN PROBE
- Water Quality
- Interdependence of Plants and Animals*

COLORIMETER
Beer's Law

LOW-G ACCELEROMETER
- Newton's Second Law*

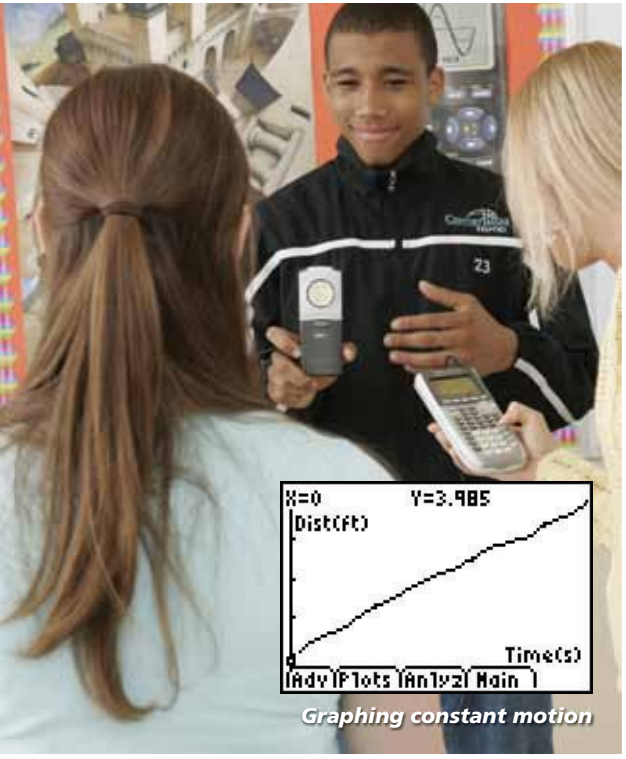
CO_2 GAS SENSOR
- Cell Respiration

LIGHT SENSOR
- Reflection and Absorption of Light*

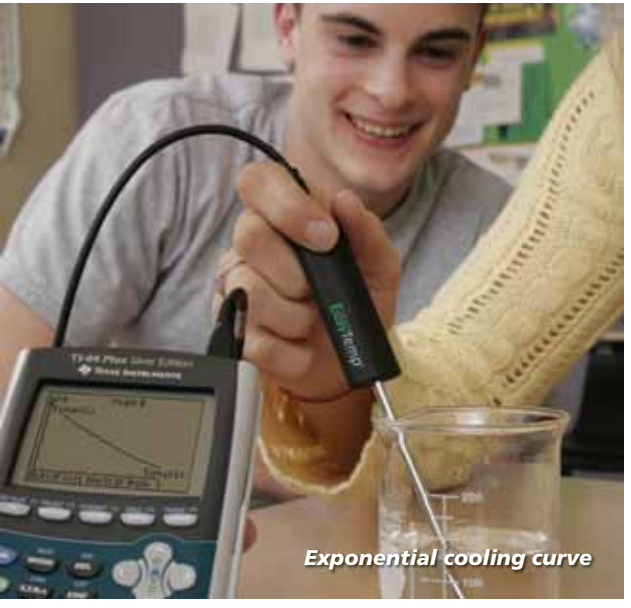
DIFFERENTIAL VOLTAGE PROBE
- Capacitors

STARTER PACKAGES DELUXE PACKAGES

*Activity Requires TI-Nspire Lab Cradle †Activity Requires a Sensor from the Deluxe Package



Graphing constant motion



Exponential cooling curve

a. EasyTemp, ORDER CODE EZ-TMP

The Vernier EasyTemp is inexpensive and easy to use! What more can you ask for? Plug Vernier EasyTemp into the USB port on a TI-84 Plus calculator or TI-Npsire handheld. The data-collection application automatically launches, and you are ready to collect data! This stainless-steel probe is durable for classroom use and covers a temperature range of –20°C to 110°C.

b. CBR 2, ORDER CODE CBR2

If you teach math, physical science or physics, consider the CBR 2. The CBR 2 collects distance, velocity, and acceleration data. It connects directly to a TI calculator. When the CBR 2 is connected to the USB port of a TI-84 Plus calculator or TI-Npsire handheld, the data-collection application automatically launches, and you are ready to collect data.

TI-Navigator™ Classroom Learning Systems

The TI-Navigator is a classroom learning system that combines Texas Instruments graphing calculators or TI-Nspire handhelds and your classroom PC to create a wireless classroom network. Teachers can use the system to assess understanding of key concepts, monitor student progress, and differentiate instruction. The included software supports automatically grading and archiving student work.

For more information, see www.vernier.com/ti-navigator.

c. For TI-83/84 or TI-73 Users

32-User Standard TI-Navigator System, ORDER CODE **TI-NAV-SD**

16-User Starter TI-Navigator System, ORDER CODE **TI-NAV-STR**

4-User TI-Navigation System Add-on‡, ORDER CODE **TI-NAV-IND**

‡ Add-on pieces require the purchase of a Standard or Starter TI-Navigator System.

d. For TI-Nspire™ or TI-Nspire CAS Users

30-User TI-Nspire Navigator™ System, ORDER CODE **TI-NAV-NS30**

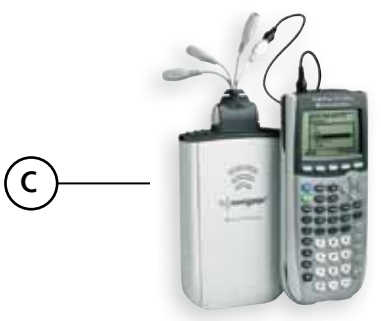
15-User TI-Nspire Navigator System, ORDER CODE **TI-NAV-NS15**

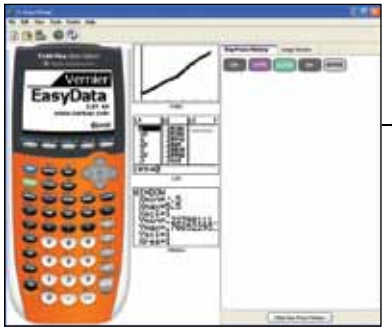
5-User TI-Nspire Navigator Add-On†, ORDER CODE **TI-NAV-NS+5**

1-User TI-Nspire Navigator Add-On†, ORDER CODE **TI-NAV-NS+1**

TI-Nspire Navigator Teacher Software Add-On†
ORDER CODE **TI-NAV-NSSW**

† Add-on pieces require the purchase of a 30-User or 15-User TI-Nspire Navigator system.





a

Save $$ with multi-user licenses of SmartView software.
See www.vernier.com/ti-smartview

b

c

Projecting Calculator Screens

a. TI-SmartView™ Emulator Software

ORDER CODE **TI-SV** *(Single-user license)*

TI-SmartView lets you project an interactive representation of a TI-84 Plus calculator to your entire class. You can use TI-SmartView to project multiple representations simultaneously (graphs, window settings, tables), display key press history, and capture multiple screen shots. TI-SmartView is ideal for use with interactive whiteboards. TI-SmartView can be used with Vernier LabPro®, TI CBL 2™, or CBR 2™ data collection devices. This capability requires a TI USB Connectivity Kit (not included).

b. ViewScreen™ Systems

The TI ViewScreen system makes it possible to project the calculator display with an overhead projector. It comes with a projection panel for the overhead projector and a modified calculator that attaches to the projection panel. If you already have a ViewScreen panel, you can purchase ViewScreen calculators by themselves.

ViewScreen Packages (includes a ViewScreen Calculator)

TI-73 Explorer ViewScreen
ORDER CODE **TI-73EXVS**

TI-84 Plus Silver Edition ViewScreen
ORDER CODE **TI-84SEVS**

For TI-Nspire or TI-Nspire CAS, you simply need to purchase a ViewScreen panel. A modified calculator is not needed.

TI-Nspire ViewScreen (calculator not included)
TI-Nspire ViewScreen panel
ORDER CODE **TI-NSVSH**

c. TI-Presenter™, ORDER CODE TI-PRE

Easily display the image of your calculator screen on your TV or a computer projector. The TI-Presenter works with all models of ViewScreen calculators. ViewScreen calculators are not included and must be purchased separately.

CALCULATOR PRODUCTS PRICE LIST

PRODUCT	ORDER
CBL 2 System	CBL2
Vernier LabPro	LABPRO
EasyLink	EZ-LINK
EasyTemp	EZ-TMP
TI-Nspire Lab Cradle	TI-NSLABC
TI-Nspire Lab Cradle Bundle	TI-NSLABC-5
Calculator-Based Ranger 2	CBR2
TI-73 Explorer Calculator	TI-73EX
TI-73 Explorer Teacher Pack	TI-73EXTP
TI-73 Explorer ViewScreen (includes calculator)	TI-73EXVS
TI-73 Explorer ViewScreen Calculator	TI-73EXVSC
TI-83 Plus Calculator	TI-83PL
TI-83 Plus Teacher Pack	TI-83PLTP
TI-84 Plus Calculator	TI-84PL
TI-84 Plus EZ Spot Teacher Pack	TI-84SPOTTP
TI-84 Plus Silver Edition Calculator	TI-84PSE
TI-84 Plus Silver Edition EZ Spot Teacher Pack	TI-84SESPTP
TI-84 Plus Silver Edition ViewScreen (includes calculator)	TI-84SEVS
TI-84 Plus Silver Edition ViewScreen Calculator	TI-84SEVSC
TI-Nspire Touchpad Handheld	TI-NS2
TI-Nspire Teacher Bundle (includes handheld & TE software)	TI-NS2-TB
TI-Nspire Teacher Pack (includes 10 handhelds)	TI-NS2-TPK
TI-Nspire CAS Touchpad Handheld	TI-NSCAS2
TI-Nspire CAS Teacher Bundle (includes handheld & TE software)	TI-NSCAS2-TB
TI-Nspire CAS Teacher Pack (includes 10 handhelds)	TI-NSCAS2-TPK
TI-Nspire Student Computer Software (single license)*	TI-NSSW-1
TI-Nspire CAS Student Computer Software (single license)*	TI-NSCASSW-1
TI-Nspire Rechargeable Battery (for Touchpad handhelds)	TI-NS2-BAT
TI-Nspire ViewScreen panel only (no calculator)	TI-NSVSH
TI ViewScreen panel only for TI-73/83/84 (no calculator)	TI-VSP
TI-Presenter (no calculator)	TI-PRE
TI-84 Presentation Link	TI-LINK84
TI USB Connectivity Kit	GLC-USB
Calculator-to-Calculator Link Cable	TI-CLC
Short Calculator Link Cable	TI-SLC
TI Kickstand Slide Cover	TI-KSC
TI SmartView Emulator software for TI-84 (single-user license)*	TI-SV
Vernier AC Adapter (for LabPro, CBL 2, CBL)	IPS
32-User Standard TI-Navigator System	TI-NAV-SD
16-User Starter TI-Navigator System	TI-NAV-STR
4-User TI-Navigator Add-on (requires a Navigator system)	TI-NAV-IND
30-User TI-Nspire Navigator System	TI-NAV-NS30
15-User TI-Nspire Navigator System	TI-NAV-NS15
5-User TI-Nspire Navigator Add-on†	TI-NAV-NS+5
1-User TI-Nspire Navigator Add-on †	TI-NAV-NS+1
TI-Nspire Navigator Teacher Software Add-on †	TI-NAV-NSSW

† Requires purchase of a Navigator system. See page 99.
* Lower-price, multi-user license software also available. See www.vernier.com/ti-nspire-licenses

OVER 70 SENSORS INCLUDING:

SENSOR	CODE	LABQUEST	LABQUEST MINI	LABPRO	GO!LINK	EASYLINK	PAGE
Accelerometers							
3-Axis Accelerometer	3D-BTA	✔	✔	✔			102
25-g Accelerometer	ACC-BTA	✔	✔	✔	✔	✔	102
Low-g Accelerometer	LGA-BTA	✔	✔	✔	✔	✔	102
NEW Anemometer	ANM-BTA	✔	✔	✔	✔	✔	102
Barometer	BAR-BTA	✔	✔	✔	✔	✔	103
Blood Pressure Sensor	BPS-BTA	✔	✔	✔*	✔	✔°	103
Charge Sensor	CRG-BTA	✔	✔	✔	✔	✔	103
CO_2 Gas Sensor	CO2-BTA	✔	✔	✔	✔	✔°	104
Colorimeter	COL-BTA	✔	✔	✔	✔	✔	104
Conductivity Probe	CON-BTA	✔	✔	✔	✔	✔	104
Current Probes							
Current Probe	DCP-BTA	✔	✔	✔	✔	✔	105
NEW High Current Sensor	HCS-BTA	✔	✔	✔	✔	✔	105
Digital Control Unit	DCU-BTD	✔†	✔	✔			105
Dissolved Oxygen Probe	DO-BTA	✔	✔	✔	✔	✔	106
Drop Counter	VDC-BTD	✔	✔	✔			106
Dual-Range Force Sensor	DFS-BTA	✔	✔	✔	✔	✔	106
EKG Sensor	EKG-BTA	✔	✔	✔	✔	✔	107
Electrode Amplifier	EA-BTA	✔	✔	✔	✔	✔	107
Flow Rate Sensor	FLO-BTA	✔	✔	✔	✔	✔	107
Force Plate	FP-BTA	✔	✔	✔	✔	✔	108
Gas Pressure Sensor	GPS-BTA	✔	✔	✔	✔	✔	108
Global Positioning System (GPS) Sensors							
Vernier GPS Sensor	VGPS	✔	*Computer USB*				108
Garmin Venture HC	GAR-VENTHC	✔	*Computer USB*				108
Hand Dynamometer	HD-BTA	✔	✔	✔	✔	✔	109
Hand-Grip Heart Rate Monitor	HGH-BTA	✔	✔	✔	✔	✔	109
Instrumentation Amplifier	INA-BTA	✔	✔	✔	✔	✔	109
Ion-Selective Electrodes							
Ammonium Ion-Selective Electrode	NH4-BTA	✔	✔	✔	✔	✔	110
Calcium Ion-Selective Electrode	CA-BTA	✔	✔	✔	✔	✔	110
Chloride Ion-Selective Electrode	CL-BTA	✔	✔	✔	✔	✔	110
Nitrate Ion-Selective Electrode	NO3-BTA	✔	✔	✔	✔	✔	110
Light Sensor	LS-BTA	✔	✔	✔	✔	✔	110
Magnetic Field Sensor	MG-BTA	✔	✔	✔	✔	✔	110
Mass (Ohaus Balances)							
Scout Pro 0.01 g balance (200 g)	OHSP-202	*Computer USB*					40
Scout Pro 0.01 g balance (400 g)	OHSP-402	*Computer USB*					40
Scout Pro 0.001 g balance (120 g)	OHSP-123	*Computer USB*					40
Adventurer Pro 0.001 g balance (300 g)	OHAP-313	*Computer USB*					web
Adventurer Pro 0.0001 g balance (110 g)	OHAP-114	*Computer USB*					web
NEW Melt Station	MLT-BTA	✔	✔	✔*	✔	✔°	111
Microphone	MCA-BTA	✔	✔	✔			111
Mini GC	GC-MINI	✔	*Computer USB*				111
Motion Detectors							
Motion Detector	MD-BTD	✔	✔	✔			112
Go!Motion	GO-MOT	✔	*Computer USB*				112
CBR 2 *(calculators only)*	CBR2	*Calculator USB and Calculator I/O*					99
O_2 Gas Sensor	O2-BTA	✔	✔	✔	✔	✔	112
ORP Sensor	ORP-BTA	✔	✔	✔	✔	✔	112
pH Sensor	PH-BTA	✔	✔	✔	✔	✔	113
pH Sensor, Tris-Compatible Flat	FPH-BTA	✔	✔	✔	✔	✔	113
Photogate	VPG-BTD	✔	✔	✔			113
Power Amplifier	PAMP	✔		✔*			114
Radiation Monitor (Digital)	DRM-BTD	✔	✔	✔			114
Relative Humidity Sensor	RH-BTA	✔	✔	✔	✔	✔	114
Respiration Monitor Belt *(requires GPS-BTA)*	RMB	✔	✔	✔	✔	✔	115
Rotary Motion Sensor	RMV-BTD	✔	✔	✔			115
Salinity Sensor	SAL-BTA	✔	✔	✔	✔	✔	115
Soil Moisture Sensor	SMS-BTA	✔	✔	✔	✔	✔	116
Sound Level Meter	SLM-BTA	✔	✔	✔	✔	✔	116
Spectrometers							
SpectroVis® Plus Spectrometer	SVIS-PL	✔	*Computer USB*				116
Ocean Optics Spectrometers							
Vernier Spectrometer	V-SPEC	✔	*Computer USB*				41
Red Tide Spectrometer	SPRT-VIS	✔	*Computer USB*				41
Red Tide UV-VIS Spectrometer	SPRT-UV-VIS	✔	*Computer USB*				41
Red Tide Emissions Spectrometer	ESRT-VIS	✔	*Computer USB*				73
Spirometer	SPR-BTA	✔	✔	✔	✔	✔	117
Temperature Probes							
EasyTemp *(calculators only)*	EZ-TMP	*Calculator USB*					99
Extra-Long Temperature Probe	TPL-BTA	✔	✔	✔	✔	✔	117
Go!Temp	GO-TEMP	✔	*Computer USB*				15
Infrared Thermometer	IRT-BTA	✔	✔	✔	✔	✔	118
Stainless Steel Temperature Probe	TMP-BTA	✔	✔	✔	✔	✔	117
Surface Temperature Sensor	STS-BTA	✔	✔	✔	✔	✔	118
Thermocouple	TCA-BTA	✔	✔	✔	✔	✔	118
Wide-Range Temperature Probe	WRT-BTA	✔	✔	✔*	✔	✔°	118
Turbidity Sensor	TRB-BTA	✔	✔	✔	✔	✔	119
UVA Sensor	UVA-BTA	✔	✔	✔	✔	✔	119
UVB Sensor	UVB-BTA	✔	✔	✔	✔	✔	119
Voltage Probes							
Differential Voltage Probe	DVP-BTA	✔	✔	✔	✔	✔	119
Voltage Probe	VP-BTA	✔	✔	✔	✔	✔	120
NEW 30-Volt Voltage Probe	30V-BTA	✔	✔	✔*	✔	✔°	120
Watts Up Pro	WU-PRO	✔	*Computer USB*				120
Wireless Dynamics Sensor System	WDSS	✔	*Wireless computer use*				120

For sensor compatibility with TI-Nspire Lab Cradle, go to www.vernier.com/ti-nspire

† *With computer only, requires Logger Pro 3.7 or newer* * *Not supported with calculators* ° *For calculators, TI-Nspire only*

The Vernier Sensor Advantage

Outstanding Performance

Vernier sensors are designed specifically for education and held to high standards for quality and durability. With 30 years of experience developing technology for education, we design our sensors for active, hands-on experiments. Vernier sensors are rugged, classroom-proven technology that are well supported and easy to use. The sensors provide consistent, high-quality results for the demands of the classroom.

Connect & Collect

AUTO ID SENSOR

Just connect and you're ready to collect. All Vernier sensors on the following pages are automatically detected and set up for data collection when used with LabQuest, LabQuest Mini, LabPro, CBL 2, Go!Link, or EasyLink, or TI-Nspire Lab Cradle (exception DCU on page 105). It's student-friendly technology designed for ease of use.

Curriculum Aligned to State Standards

Vernier sensors are supported by over 400 detailed, engaging experiments written by teachers, scientists, and technology experts. See how data-collection technology aligns to your curriculum at www.vernier.com/standards

Generous Warranty

Buy with confidence. Most Vernier sensors are covered by a 5-year warranty. In Vernier's 30 years of business, we have rarely charged a customer for a repair, no matter how old the equipment.

Accelerometers
Low-g, 25-g and 3-Axis

We have three accelerometers designed for different uses. These small devices can be mounted on objects to study motion. All are individually calibrated.

3-Axis Accelerometer
ORDER CODE **3D-BTA**

Use this for studying the complex motion of an amusement park ride, a bungee jump, or simply a toss in the air.

RANGE: -50 to +50 m/s^2 **TYPICAL ACCURACY:** ±0.1 m/s^2

Low-g Accelerometer, ORDER CODE LGA-BTA

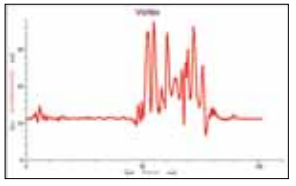
This is the best choice for most experiments. Use it for studying the one-dimensional motion of a car (real and toy), elevator, pendulum bob, or amusement park ride.

RANGE: -50 to +50 m/s^2 **TYPICAL ACCURACY:** ±0.1 m/s^2

25-g Accelerometer, ORDER CODE ACC-BTA

This is great for studying one-dimensional collisions or any motion with larger accelerations.

RANGE: -250 to +250 m/s^2 **TYPICAL ACCURACY:** ±1 m/s^2



Accelerations during the Vortex amusement park ride

See also WDSS on page 120.

GREAT WAYS TO USE THESE SENSORS!

PHYSICS
- Bungee jump accelerations
- Newton's second law
- Centripetal acceleration on a turntable
- Acceleration on a merry-go-round

HUMAN PHYSIOLOGY
- Neuromuscular reflexes

INNOVATIVE USE
- Accelerations on the half pipe
- Accelerations in snowboarding

NEW Anemometer

ORDER CODE
ANM-BTA

The Vernier Anemometer is an impeller-type anemometer that measures wind speed in the range of 0.5 to 30 m/s (1 to 67 mph). The Anemometer fits in your palm for wind study measurements in the field. A standard camera mounts on the back and an accessory rod allows you to position it in wind tunnels or in front of fans for wind turbine experiments.

RANGE: 0.5 m/s ~ 30 m/s

RESOLUTION:
10-bit resolution (using CBL2): 4.8 x 10^{-2} m/s
12-bit resolution (using LabQuest, LabQuest Mini, LabPro, Go!Link, Easy Link): 1.2 x 10^{-2} m/s
13-bit resolution (using SensorDAQ): 6.0 x 10^{-2} m/s

Measuring wind speed in a wind turbine experiment

GREAT WAYS TO USE THIS SENSOR!

ENVIRONMENTAL
- Measure the wind speed of air
- Measure the effects of design on windmill's output
- Measure wind speed in wind tunnels
- Measure the affects on cooling rate
- Use with compass to determine wind direction
- Investigate wind speed over land and water

Barometer

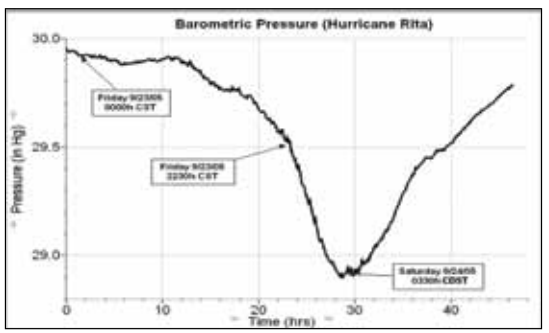
ORDER CODE
BAR-BTA

Our Barometer can be used for weather studies or for lab experiments involving pressures close to normal air pressure.

RANGE: 25.0 to 31.5 in Hg; 81 to 106 kPa; 0.80 to 1.05 atm; 600 to 800 mm Hg

RESOLUTION:
12-bit (LabQuest, LabQuest Mini, LabPro, Go! Link, SensorDAQ): 0.003 in Hg

10-bit (CBL, CBL 2, NXT Adapter): 0.01 in Hg



Atmospheric pressure data collected during Hurricane Rita in 2005

GREAT WAYS TO USE THIS SENSOR!

EARTH SCIENCE
- Barometric pressure
- Local weather study

INNOVATIVE USE
- Study the barometric pressure of storms
- Use it as an altimeter
- Study Bernoulli's principle

Blood Pressure Sensor

ORDER CODE
BPS-BTA

The Blood Pressure Sensor is a noninvasive sensor designed to measure human blood pressure.

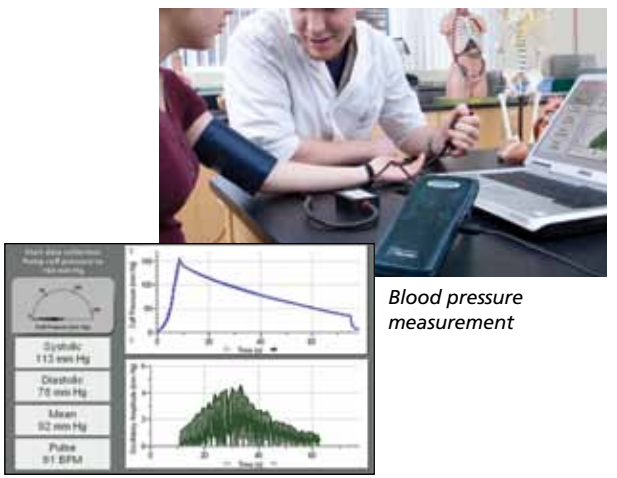
- Measures systolic and diastolic blood pressure utilizing the oscillometric technique.
- Includes a standard adult size adjustable cuff (27 cm to 39 cm), pump bulb, and pressure transducer.

Additional cuff sizes are available for best results on small or large arms. Each includes cuff, pump, and valve.

- **Small Cuff,** 18 cm to 27 cm, ORDER CODE **CUFF-SM**
- **Large Cuff,** 35 cm to 51 cm, ORDER CODE **CUFF-LG**

PRESSURE RANGE:
20 mm Hg to 250 mm Hg

TYPICAL ACCURACY: ±3 mm Hg



Blood pressure measurement

GREAT WAYS TO USE THIS SENSOR!

HUMAN PHYSIOLOGY
- Blood pressure as a vital sign
- Effect of exercise on blood pressure
- Diurnal blood pressure variation
- Heart rate and blood pressure as vital signs
- Heart rate, blood pressure, and exercise

Charge Sensor

ORDER CODE
CRG-BTA

Use the Charge Sensor as an electronic electroscope to obtain quantitative measurements when studying charging by induction, friction, or contact.

- A 0.01 µF input capacitor makes it possible for this extremely high impedance voltage sensor to be used in many electrostatic experiments.
- Range switch allows you to adjust sensitivity.
- Zero switch discharges the input capacitor between runs.

RANGES: ±0.5 V (+/- 5 nC); ±2 V (+/- 20 nC); ±10 V (+/- 100 nC)

Typical bias current: 0.005 pA
Input capacitance: 0.01 µF

Electrostatics Kit

ORDER CODE **ESK-CRG**

The Electrostatics Kit is an accessory for the Vernier Charge Sensor. The kit includes a faraday pail and cage, grounding plane, grounding wires and wrist strap, charge producers and proof plane, wool, vinyl, nylon rod, PVC rod, and a cotton cloth. See page 75.

High Voltage Electrostatics Kit

ORDER CODE **HVEK-CRG**

The Electrostatics Kit is an accessory for the Vernier Charge Sensor. The kit includes an electrostatics voltage source (output 750, 1500, 3000, 6000 V DC) and two conducting spheres. Extremely low output current makes this device safe for classroom use. See page 75.

GREAT WAYS TO USE THIS SENSOR!

INNOVATIVE USES
- Use as electronic electroscope
- Charging by induction, by friction, and by contact
- Measure charge polarity

More innovative uses from teachers at www.vernier.com/innovate

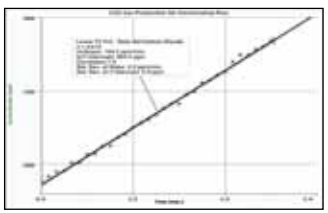
CO_2 Gas Sensor

ORDER CODE
CO2-BTA

The CO_2 Gas Sensor measures gaseous carbon dioxide in two ranges—0 to 10,000 ppm and 0 to 100,000 ppm.

- Explore human respiratory changes in CO_2 levels based on exercise with the high range.
- The lower range offers more sensitivity and a wider interval for cellular respiration and photosynthetic metabolism studies.

RANGE: Low 0–10,000 ppm
High 0–100,000 ppm



Measuring CO_2 levels of germinating peas

BioChambers

BioChambers provide a way for both CO_2 Gas and O_2 Gas sensors to be used at the same time in a closed system.

BioChamber 2000, 2000 mL
ORDER CODE **BC-2000**

BioChamber 250, 250 mL
ORDER CODE **BC-250**

GREAT WAYS TO USE THIS SENSOR!

BIOLOGY
- Cell respiration in peas
- Respiration of sugars by yeast
- Effect of temperature on cold-blooded organisms
- Photosynthesis and respiration
- Levels of CO_2 in human respiration
- Measure CO_2 along with O_2 in respiration and photosynthesis

ENVIRONMENTAL SCIENCE
- Investigating indoor CO_2 concentrations

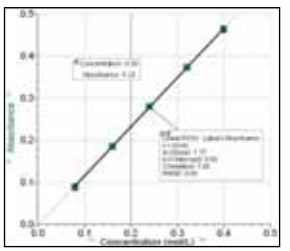
Colorimeter

ORDER CODE
COL-BTA

This 4-wavelength Colorimeter features one-button automatic calibration. Fifteen 3.5 mL cuvettes are included. A package of 100 replacement cuvettes (with 20 lids) is available (ORDER CODE CUV).

WAVELENGTHS: 430 nm 470 nm 565 nm 635 nm

RESOLUTION:
12-bit (LabQuest, LabQuest Mini, LabPro, Go!Link, SensorDAQ): 0.04 %T
10-bit (CBL, CBL 2, NXT Adapter): 0.16 %T



Beer's law experiment

Cuvette Rack

ORDER CODE **CUV-RACK**

No more spills! Holds 10 standard cuvettes.

GREAT WAYS TO USE THIS SENSOR!

CHEMISTRY
- Beer's law: determining the concentration of unknown substances
- Kinetics: rate and order of a chemical reaction
- Rate determination and activation energy
- Chemical equilibrium: Finding a constant, K_c
- Rate law determination of the crystal violet reaction

BIOLOGY
- Photosynthesis
- The effect of alcohol on biological membranes
- Population dynamics

WATER QUALITY
- Ortho- and total-phosphates concentration

FORENSICS
- Identifying an unknown ink by its light absorbance characteristics

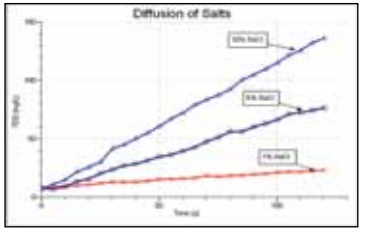
Conductivity Probe

ORDER CODE
CON-BTA

This probe measures the electrical conductivity of water. It is an important part of chemistry, biology, and water quality studies.

AUTOMATIC TEMPERATURE COMPENSATION: 5°C – 35°C

LOW RANGE:	MEDIUM RANGE:	HIGH RANGE:
0–200 µS/cm (0–100 mg/L TDS)	0–2000 µS/cm (0–1000 mg/L TDS)	0–20000 µS/cm (0–10000 mg/L TDS)
RESOLUTION:	**RESOLUTION:**	**RESOLUTION:**
12-bit (LabQuest, LabQuest Mini, LabPro, Go!Link, SensorDAQ): 0.1 µS/cm	12-bit (LabQuest, LabQuest Mini, LabPro, Go!Link, SensorDAQ): 1 µS/cm	12-bit (LabQuest, LabQuest Mini, LabPro, Go!Link, SensorDAQ): 10 µS/cm
10-bit (CBL, CBL 2, NXT Adapter): 0.4 µS/cm	10-bit (CBL, CBL 2, NXT Adapter): 4 µS/cm	10-bit (CBL, CBL 2, NXT Adapter): 40 µS/cm



Diffusion through membranes

GREAT WAYS TO USE THIS SENSOR!

BIOLOGY
- Diffusion of ions through membranes
- Monitor changes in ion levels in aquatic systems
- Limitations of cell size: surface area to volume

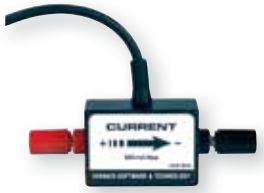
MIDDLE SCHOOL
- Water hardness study
- Diffusion: how fast?

CHEMISTRY
- Investigate ionic and molecular compounds, strong and weak acids
- Conductimetric titrations
- Investigate ionic concentrations and conductivity levels

WATER QUALITY
- Total dissolved solids

PHYSICAL SCIENCE
- Acid strengths

Current Probes



Current Probe

ORDER CODE
DCP-BTA

Use the Current Probe to measure currents in low-voltage AC and DC circuits. With a range of ±0.6 A, this probe is ideal for use in most battery and bulb circuits. Use multiple sensors to explore series and parallel circuits. It can also be used in electrochemistry experiments.

RANGE: -0.6 to +0.6 A **SENSE RESISTOR:** 0.1 Ω
RESOLUTION:
12-bit (LabQuest, LabQuest Mini, LabPro, Go!Link, SensorDAQ): 0.3 mA
10-bit (CBL, CBL 2, NXT Adapter): 1.25 mA

Students studying Ohm's law using the Current Probe, Differential Voltage Probe, and the Vernier Circuit Board

GREAT WAYS TO USE THIS SENSOR!

PHYSICS
- Ohm's law
- Series and parallel circuits
- Electrical energy

CHEMISTRY
- Electroplating
- Determining Avogadro's number

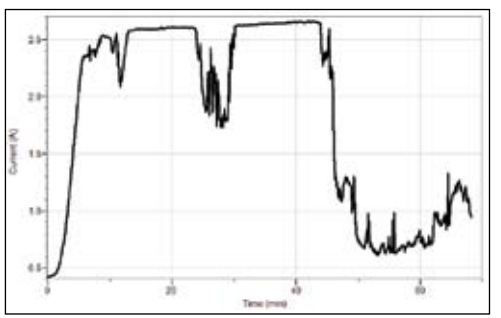
ENVIRONMENTAL SCIENCE
- Solar energy: photovoltaic cells
- Wind energy

NEW High Current Sensor

ORDER CODE
HCS-BTA

The High Current Sensor is used to measure current in the range of –10 to +10 A. The sensor uses a Hall Effect chip, so that it does not add a resistive element to your circuit. A metal shield over the Hall Effect chip reduces the influence of external magnets. A replaceable fuse protects the equipment and circuit.

RANGE SETTINGS: 10 A; maximum voltage input 40 V
RESOLUTION:
13-bit resolution (using SensorDaq): 2.4 mA
12-bit resolution (using LabQuest, LabQuest Mini, LabPro, Go! Link): 4.9 mA



Current produced by a large solar panel vs. time

GREAT WAYS TO USE THIS SENSOR!

INNOVATIVE USES
- Record currents from a solar panel
- Record currents from hand generator

Digital Control Unit

ORDER CODE
DCU-BTD

The Digital Control Unit (DCU) makes it easy to use the digital ports on SensorDAQ, LabQuest, LabQuest Mini, LabPro, or CBL 2 for exciting, do-it-yourself projects.

- Write simple programs to control motors, lamps, LEDs, buzzers, and other DC devices.
- Develop elaborate projects to control robots or automated scientific apparatuses in combination with other sensors.

Provides up to 600 mA of current.

The Digital Control Unit used to make an automated tea brewer

Includes:
- A manual with project ideas
- Explanations of how to write DCU programs in LabVIEW using SensorDAQ
- Wiring diagrams
- Sample programs included on CD
- A cable for connecting electrical devices that you build
- Explanation of DCU programming using our LabPro interface and LabVIEW®, or TI graphing calculator programs

DCU Power Supply, ORDER CODE **IPS**

Note: The Digital Control Unit does not work with LabQuest App at this time, but will work with LabQuest and Logger *Pro* 3.7 and newer.

GREAT WAYS TO USE THIS SENSOR!

ENGINEERING
- Pulse a speaker to generate sound
- Make an alarm system
- Make a robot
- Create temperature-controlled environments
- Moving displays
- Flash lamps on LEDs

Dissolved Oxygen Probe

ORDER CODE
DO-BTA

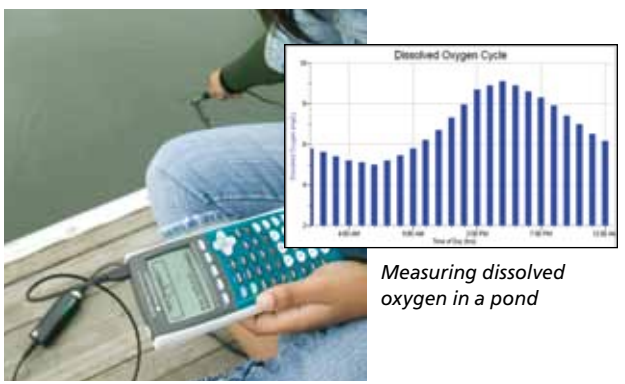
Use the Dissolved Oxygen Probe to determine the concentration of oxygen in aqueous solutions.

- Built-in temperature compensation and a fast response time.
- Includes zero-oxygen solution, two caps fitted with membranes, a 100% calibration bottle, and electrode filling solution. Replacement membrane caps are available (ORDER CODE MEM).

AUTOMATIC TEMPERATURE COMPENSATION: 5°C to 35°C

RANGE: 0 to 14 mg/L

RESOLUTION:
12-bit (LabQuest, LabQuest Mini, LabPro, Go!Link, SensorDAQ): 0.007 mg/L
10-bit (CBL, CBL 2, NXT Adapter): 0.028 mg/L



Measuring dissolved oxygen in a pond

GREAT WAYS TO USE THIS SENSOR!

BIOLOGY
- Interdependence of plants and animals
- Aerobic respiration
- Dissolved oxygen *vs.* time
- Watershed testing
- Physical profile of a lake
- Primary productivity

WATER QUALITY
- Dissolved oxygen concentration
- Biochemical oxygen demand (BOD)

ENVIRONMENTAL SCIENCE
- Long term water monitoring
- Investigating dissolved oxygen

Drop Counter

ORDER CODE
VDC-BTD

Use the Drop Counter with our pH Sensor, Conductivity Probe, or ORP Sensor to easily perform conductimetric or potentiometric titrations.

- Precisely records the number of drops of titrant added during a titration, which is automatically converted into volume.
- Includes a cable, Microstirrer (shown below), dispensing vessel, and reagent reservoir.

A Microstirrer is included with the Drop Counter. Additional Microstirrers are available (ORDER CODE MSTIR).

GREAT WAYS TO USE THIS SENSOR!

CHEMISTRY
- Acid-based titration
- Standardizing a solution of sodium hydroxide
- Oxidation-reduction titration
- Investigating indicators
- Conductimetric titration and gravimetric determination of a precipitate
- Potentiometric titration of hydrogen peroxide

Dual-Range Force Sensor

ORDER CODE
DFS-BTA

Our Dual-Range Force Sensor can be easily mounted on a ring stand or dynamics cart or used as a replacement for a hand-held spring scale. It has two ranges: ±10 N and ±50 N and resolution of 0.01 N and 0.05 N, respectively.

Dual-Range Force Sensor Accessories

Bumper and Launcher Kit
ORDER CODE **BLK**
See page 77 for more information.

Air Track Adapter
ORDER CODE **ATA-DFS**
Allows the Dual-Range Force Sensor to be mounted on the end of an air track for collision studies. Compatible with most air tracks. Includes two magnetic bumpers.

Force Table Adapter
ORDER CODE **FTA-DFS**
Use your Dual-Range Force Sensor with your force table for resolution of vectors experiments. Includes mounting clamp.

Mass For Dynamics Cart
ORDER CODE **MASS**
This 500 g steel block is a great accessory for Newton's second law labs. It attaches to a dynamics cart and leaves room for both a Dual-Range Force Sensor and an Accelerometer.

GREAT WAYS TO USE THESE SENSORS!

PHYSICS
- Newton's second law
- Newton's third law
- Static and kinetic friction
- Impulse and momentum

PHYSICAL SCIENCE
- Frictional forces
- Pulleys

MIDDLE SCHOOL
- Friction
- First-class levers

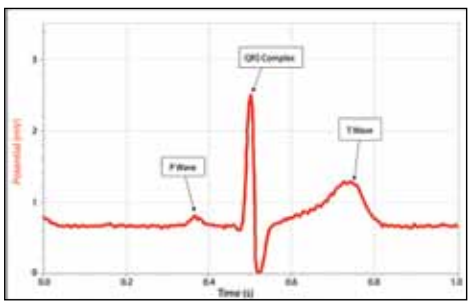
EKG Sensor

ORDER CODE
EKG-BTA

Use the EKG Sensor to measure electrical signals produced during muscle contractions.

- Make standard 3-lead EKG tracings to record electrical activity in the heart.
- Collect surface EMG recordings to study contractions in muscles in your arm, leg, or jaw.

Each sensor includes a package of 100 disposable electrodes. Additional packages of 100 electrodes are available (ORDER CODE ELEC).



EKG graph demonstrating the contraction and repolarization of the heart's chambers

GREAT WAYS TO USE THIS SENSOR!

HUMAN PHYSIOLOGY
- Analyzing the heart with EKG
- Introduction to EMG
- Neuromuscular reflexes
- Muscle function analysis
- EMG and muscle fatigue

BIOLOGY
- Monitoring EKG

INNOVATIVE USE
- Monitor the heart rate of crawfish

Electrode Amplifier

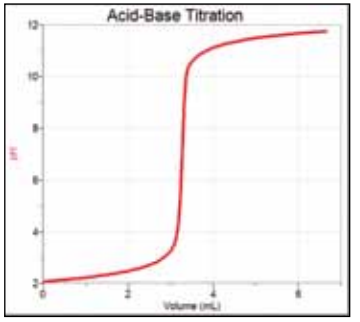
ORDER CODE
EA-BTA

This newly designed sensor is a mV/pH/ORP amplifier that accepts an electrode with a standard BNC connector. It amplifies a –450 mV to +1100 mV signal to a 0 to 5 V range.

It can be used with any of the following:

- Vernier Replacement pH Electrode (ORDER CODE 7120B)
- Most third-party pH electrodes (with BNC connectors)
- Other high output impedance electrodes
- Most third-party ORP electrodes (with BNC connectors)

See page 113 for our pH Sensor option.



Acid-base titration curve

BUY WITH CONFIDENCE

Vernier's 5-year warranty gives you a superior level of buying confidence. In fact, in Vernier's 30 years of business, we have rarely charged a customer for a repair, no matter how old the equipment!

Flow Rate Sensor

ORDER CODE
FLO-BTA

Use the Flow Rate Sensor to easily measure stream velocity for environmental or Earth science studies. Flow rate data can be used to calculate the discharge value for the stream or determine the sediment transport of the stream.

- Separates into four sections for easy transport and convenient storage.
- Equipped with a 5 m cable, so your data-collection equipment can stay on shore.
- Includes 3 riser rods, which enable the impeller to be placed at fixed depths.

RANGE: 0 to 4 m/s

RESOLUTION:
12-bit (LabQuest, LabQuest Mini, LabPro, Go!Link, SensorDAQ): 0.0012 m/s
10-bit (CBL, CBL 2, NXT Adapter): 0.005 m/s

Collecting flow rate data with a LabQuest

GREAT WAYS TO USE THIS SENSOR!

WATER QUALITY
- Measure stream flow rates
- Investigate sediment transport
- Determine stream discharge values

Force Plate

ORDER CODE
FP-BTA

The Force Plate is a large force sensor—tough enough to jump on. About the size and shape of a bathroom scale, the Force Plate has two ranges, one reading up to 3500 N and the other to 800 N. Two handles are included for pushing or pulling. Additional pairs of handles are available (ORDER CODE FP-HAN).

RANGE: -850 to 3500 N and -200 to 850 N

RESOLUTION:
12-bit (LabQuest, LabQuest Mini, LabPro, Go!Link, SensorDAQ): 1.2 N or 0.3 N
10-bit (CBL, CBL 2, NXT Adapter): 4.8 N or 1.2 N

Studying Newton's third law

GREAT WAYS TO USE THIS SENSOR!

INNOVATIVE USES
- Study the dynamics of jumping and walking
- Study how the normal force on your feet changes during an elevator ride
- Try pushing a car across the parking lot
- Use two Force Plates to study Newton's third law

Gas Pressure Sensor

ORDER CODE
GPS-BTA

The Gas Pressure Sensor has sufficient resolution and range to work for many subject areas:

Chemistry
- Wide enough range for Boyle's law experiments.
- Sufficient resolution for vapor-pressure or pressure-temperature experiments.

Biology
- Use the included airtight tubing clamps for transpiration experiments.
- Perform respiration experiments in small containers using included fittings.

Includes the Pressure Sensor Accessories Kit (shown above). For replacement parts, see page 121.

RANGE: 0 to 210 kPa (0 to 2.1 atm or 0 to 1600 mm Hg)

RESOLUTION:
12-bit (LabQuest, LabQuest Mini, LabPro, Go!Link, SensorDAQ): 0.05 kPa (0.0005 atm or 0.40 mm Hg)
10-bit (CBL or CBL 2, NXT Adapter): 0.2 kPa (0.002 atm or 1.6 mm Hg)

GREAT WAYS TO USE THIS SENSOR!

BIOLOGY
- Transpiration
- Enzyme action: testing catalase activity
- Sugar fermentation

MATH
- Under pressure: the inverse relationship between pressure and volume

PHYSICAL SCIENCE
- Gas pressure and volume
- Gas temperature and pressure

CHEMISTRY
- Boyle's law
- Pressure-temperature
- Volume-temperature relationship in gases
- Vapor pressure of liquids
- Ideal gas law investigation

MIDDLE SCHOOL
- Get a grip!
- Fun with pressure

Global Positioning Systems (GPS)

Vernier GPS Sensor

ORDER CODE
VGPS

The Vernier Global Positioning System (GPS) Sensor collects latitude, longitude, and altitude, right on your LabQuest or computer.

- See a real-time graphs of latitude *vs*. longitude, or export the data to various mapping programs, including Google Maps or ArcGIS.
- Connects directly to the USB port on a computer or LabQuest

Use GPS to enhance data collection:
- Performing water quality tests at multiple sites? Record your location as you make measurements, and then map the data using Logger *Pro*.
- Studying acceleration in a car or train? Collect location information along with acceleration data and display a color-coded map.

GARMIN

eTrex Venture HC

ORDER CODE
GAR-VENTHC

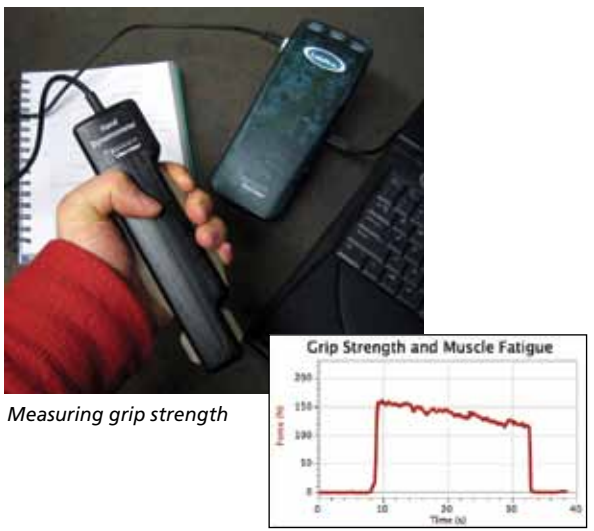
Attach this Garmin GPS unit to your LabQuest or to a computer running Logger *Pro* to collect location data in real time or to upload waypoints and tracks. USB cable included.
- A high-sensitivity GPS receiver for peak performance in any environment.
- 256-color, sunlight-readable display makes it easy to distinguish map details—even in bright sunlight.

Hand Dynamometer

ORDER CODE
HD-BTA

Our strain-gage based isometric dynamometer can be used to measure grip strength or finger pinch strength. The Hand Dynamometer can be used alone or in combination with EMG recordings for detailed studies of muscular activity. Measurements can be made in newtons or kilograms of force.

FORCE RANGE: 0–600 N **TYPICAL ACCURACY:** ±0.06 N



Measuring grip strength

GREAT WAYS TO USE THIS SENSOR!

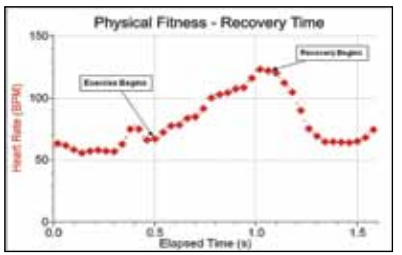
HUMAN PHYSIOLOGY
- Grip strength comparison
- Grip strength and muscle fatigue
- EMG and muscle strength
- Measure pinch strength in fingers

Hand-Grip Heart Rate Monitor

ORDER CODE
HGH-BTA

The Hand-Grip Heart Rate Monitor is ideal for continuously monitoring heart rate before, during, and after exercise or while a person is stationary.
- Hand grips do not require electrodes or clips.
- Easily shared between students.

Hand grips detect electrical pulses generated by the heart, wirelessly transmit a signal to the receiver module, and the individual's pulse or heart rate is calculated.



Recovery rate determined by monitoring heart rate

Chest Belt Transmitter

ORDER CODE **CBT**

You can use our Chest Belt Transmitter in conjunction with the Hand-Grip Heart Rate Monitor's receiver for a hands-free option of measuring heart rate.

GREAT WAYS TO USE THESE SENSORS!

HUMAN PHYSIOLOGY
- Heart rate as a vital sign
- Heart rate and exercise
- Heart rate and blood pressure as vital signs
- Effect of coughing on heart rate
- Response to baroreceptor feedback

MIDDLE SCHOOL
- Heart rate and body position
- Heart rate and exercise

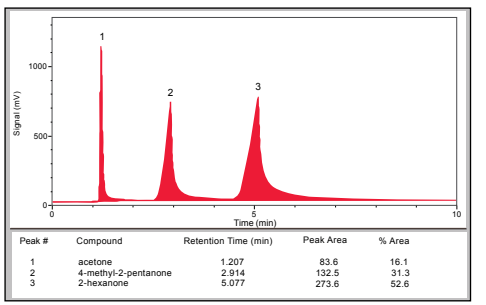
BIOLOGY
- Heart rate and physical fitness
- Ventilation and heart rate

Instrumentation Amplifier

ORDER CODE
INA-BTA

The Instrumentation Amplifier includes auto-ID functionality for each of the six ranges. New input bandwidth of 10 kHz allows the capture of higher frequency signals. The Instrumentation Amplifier monitors voltages from 20 mV to 1 V (DC or AC). It has several switch settings to allow you to select the best gain. It is typically used to amplify the chart recorder or analog output of any instrument, such as a third-party gas chromatograph.

RANGE SETTINGS: 0-20 mV, 0-200 mV, 0-1 V, ±20 mV, ±200 mV, ±1 V



Peak #	Compound	Retention Time (min)	Peak Area	% Area
1	acetone	1.207	83.6	16.1
2	4-methyl-2-pentanone	2.914	132.5	31.3
3	2-hexanone	5.077	273.6	52.6

Data collected using an Instrumentation Amplifier attached to a third-party gas chromatograph

GREAT WAYS TO USE THIS SENSOR!

INNOVATIVE USES
- Investigating resistivity
- Use to amplify signals from third-party laboratory instruments
- Use to replace a strip-chart recorder for recording instrument data

Ion-Selective Electrodes

ORDER CODE
SEE BELOW

Our Ion-Selective Electrodes (ISEs) are for monitoring four environmentally important ions: Nitrate (NO_3^-), Chloride (Cl^-), Calcium (Ca^{2+}), and Ammonium (NH_4^+).

- The Nitrate, Calcium, and Ammonium ISEs are combination-style, non-refillable, and gel-filled. The Chloride ISE is a solid state device; it does not have a replacement module.
- Vernier ISE membranes, like all other PVC ISE membranes, have a limited life expectancy. However, the replaceable module of Vernier ISEs allows you to simply discard the used membrane module, and replace it with a new one. For information about replacement modules, see page 121.
- Included with each ISE are two calibration standards and a short-term soaking bottle. To purchase additional standards, see page 121.

AMMONIUM ISE:
RANGE: 0.1 to 18,000 mg/L or ppm
RESOLUTION:
12-bit (LabQuest, LabQuest Mini, LabPro, Go!Link): 0.7% of reading
10-bit (CBL, CBL 2): 2.8% of reading

CHLORIDE ISE:
RANGE: 1.8 to 35,000 mg/L or ppm
RESOLUTION:
12-bit (LabQuest, LabQuest Mini, LabPro, Go!Link): 0.7% of reading
10-bit (CBL, CBL 2): 2.8% of reading

CALCIUM ISE:
RANGE: 0.2 to 40,000 mg/L or ppm
RESOLUTION:
12-bit (LabQuest, LabQuest Mini, LabPro, Go!Link): 1.4% of reading
10-bit (CBL, CBL 2): 5.6% of reading

NITRATE ISE:
RANGE: 0.1 to 14,000 mg/L or ppm
RESOLUTION:
12-bit (LabQuest, LabQuest Mini, LabPro, Go!Link): 0.7% of reading
10-bit (CBL, CBL 2): 2.8% of reading

Nitrate ISE
ORDER CODE **NO3-BTA**

Calcium ISE
ORDER CODE **CA-BTA**

Chloride ISE
ORDER CODE **CL-BTA**

Ammonium ISE
ORDER CODE **NH4-BTA**

Ion-Selective Electrodes require good chemical technique and careful calibration to obtain accurate results. They are not recommended for middle school or elementary school students.

GREAT WAYS TO USE THESE SENSORS!

WATER QUALITY
- Calcium and water hardness
- Chloride and salinity
- Monitor ammonium concentration
- Monitor nitrate concentration

Light Sensor

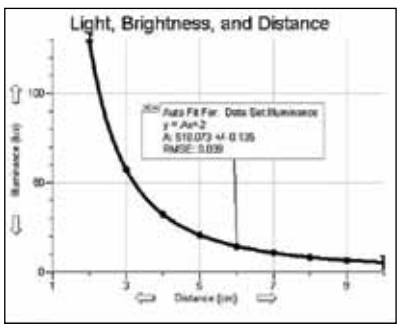
ORDER CODE
LS-BTA

Our Light Sensor approximates the human eye in spectral response and can be used over three different illumination ranges, which you select with a switch. Use it for inverse-square law experiments, or for studying polarizers, reflectivity, or solar energy.

LOW RANGE:
0 to 600 lux

MEDIUM RANGE:
0 to 6000 lux

HIGH RANGE:
0 to 150,000 lux



Inverse square law of light

GREAT WAYS TO USE THIS SENSOR!

PHYSICS
- Polarization of light
- Inverse square law

PHYSICAL SCIENCE
- Reflectivity of light
- Polaroid filters
- How bright is the light?

MATH
- Inverse square relationship
- Periodic phenomena

MIDDLE SCHOOL
- Reflectivity of light
- Schoolyard study

EARTH SCIENCE
- Reflection and absorption of light
- Photovoltaic cells
- Measuring particulates

Magnetic Field Sensor

ORDER CODE
MG-BTA

Use the Magnetic Field Sensor to study the field around permanent magnets, coils, and electrical devices.

- Sensitive enough to measure the Earth's magnetic field.
- Rotating tip allows you to measure both transverse and longitudinal magnetic fields.

LOW SENSITIVITY:
RANGE: -6.4 to +6.4 millitesla (mT)

HIGH SENSITIVITY:
RANGE: -0.32 to +0.32 mT

Measuring the magnetic field in a coil

GREAT WAYS TO USE THIS SENSOR!

PHYSICS
- The magnetic field in a coil
- The magnetic field in a slinky
- The magnetic field of a permanent magnet

PHYSICAL SCIENCE
- Electromagnets

MIDDLE SCHOOL
- Mapping a magnetic field

EARTH SCIENCE
- Exploring magnetism
- Where is north?
- Searching for iron ore

NEW Melt Station

ORDER CODE
MLT-BTA

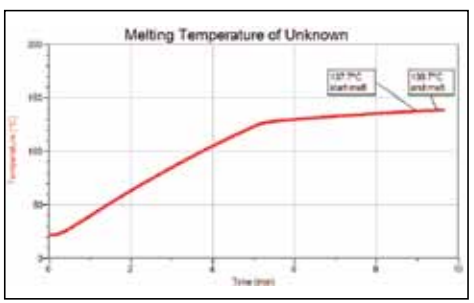
AVAILABLE MARCH 2011

Our new Melt Station connects to Vernier computer interfaces to measure the melting temperature of solid substances.

- Accurate results using built-in RTD over a range of 20°C to 260°C
- High-quality 6X viewing lens for clear observation of the samples
- Innovative, adjustable tilt allows for optimal viewing angle
- Cooling fan reduces time between tests

Each Melt Station comes with 100 standard capillary tubes. Additional packages of 100 are available, (ORDER CODE MLT-TUBE).

RANGE: 20°C to 260°C
ACCURACY: ± 0.2°C up to 200°C, ± 0.4°C above 200°C
RESOLUTION: 0.10°C
CALIBRATION: factory calibrated
POWER: separate AC power supply (included)
DIMENSIONS: 9 cm × 11 cm × 26 cm
FOOTPRINT: 13 cm × 15 cm

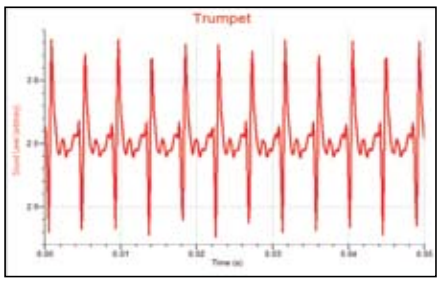


Sample graph of temperature vs. *time marking the melting temperature*

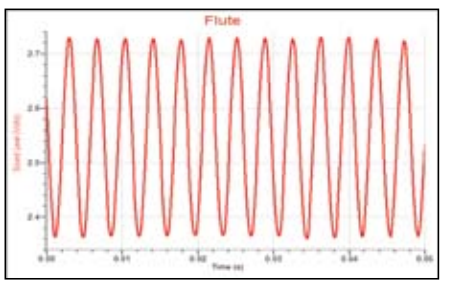
Microphone

ORDER CODE
MCA-BTA

Our Microphone can be used to display and study the waveforms of sounds from voices and musical instruments. It is also great for speed of sound experiments.



Waveform of a trumpet



Waveform of a flute

GREAT WAYS TO USE THIS SENSOR!

PHYSICS
- Sound waves and beats
- Tones, vowels and telephones
- Investigate musical scales
- Speed of sound

MATH
- Sound waveform modeling

FORENSICS
- Identify the musical notes that make up the combination to a safe

Mini GC

ORDER CODE
GC-MINI

The Vernier Mini GC gas chromatograph lets students separate and identify compounds using newly patented technology that allows air to be used as a carrier gas. Analysis and peak integration may be performed using either LabQuest as a standalone device or with Logger *Pro* software on a computer.

FAMILIES OF COMPOUNDS THAT CAN BE USED IN THE MINI GC:
Alcohols, aldehydes, aromatic hydrocarbons, carboxylic acids, chlorinated hydrocarbons, esters, ethers, ketones, and nitriles.

MEMS DETECTOR:
The unique Seacoast Science MEMS Chemi-Capacitive Detector is state-of-the-art technology that allows air to be used as a carrier gas (three existing patents and one patent pending).

COLUMN:
High-quality Restek MXT-1 stainless steel capillary column (11 meter)

TEMPERATURE REGULATION:
Software-controlled temperature regulation from 30–120°C

COLUMN TEMPERATURE RAMP:
- Maximum of 10°C/minute
- Short warm-up time: <10 minute max for most labs

PRESSURE REGULATION:
Software-controlled pressure regulation from 1–21 kPa above ambient

INJECTION:
- Comes with one high-quality 1 µL Hamilton syringe, 7.3 cm stainless needle with non-coring beveled tip and needle guard, 3.8 cm injectable length
- Injection is direct from syringe to column
- 2 extra septa included with purchase (>150 injections/septa)
- Liquid injection volume: 0.01 to 0.50 µL

More details on pp. 38–39.

GREAT WAYS TO USE THIS SENSOR!

CHEMISTRY
- Using a gas chromatograph: identifying unknown compounds
- Verification of esterification
- Quantifying substances in a mixture
- Fractional distillation
- Investigating gas chromatography

Motion Detectors

Motion Detector

ORDER CODE
MD-BTD

The Motion Detector uses ultrasound to measure the position of carts, balls, people, and other objects.

- Measure objects as close as 15 cm and as far away as 6 m.
- Sensitivity switch reduces noise and produces higher quality data for studying dynamics carts on tracks.
- Attaches easily to the Vernier Dynamics System.
- Pivoting head allows for flexibility in the experiment setup.
- Can be used with LabQuest, LabQuest Mini, LabPro, and CBL 2.

RANGE:	RESOLUTION:	SENSITIVITY:
0.15 to +6 meters	1 mm	2 settings

Go! Motion

ORDER CODE
GO-MOT

The Go!Motion has the same features as our Motion Detector but connects directly to your computer or LabQuest by USB—no other equipment is needed.

RANGE:	RESOLUTION:	SENSITIVITY:
0.15 to +6 meters	1 mm	2 settings

Motion Detector Clamp

ORDER CODE **MD-CLAMP**

The Motion Detector Clamp attaches to the back of the Motion Detector or Go! Motion. The clamp can be attached to a variety of objects, such as table tops and ring stands.

O_2 Gas Sensor

ORDER CODE
O2-BTA

The O_2 Gas Sensor measures oxygen concentration in air. The wide measurement range allows it to be used to study human and cellular respiration.

- Perform or complement many experiments conducted using the CO_2 Gas Sensor.
- Temperature compensated for use in different environments.
- Includes a 250 mL bottle that can be used to study the rusting of iron or as a respiration chamber for monitoring plants and insects.

RANGE: 0 to 27% (0 to 270 ppt)
RESOLUTION:
12-bit (LabQuest, LabQuest Mini, LabPro, Go!Link, SensorDAQ): 0.01%
10-bit (CBL, CBL 2, NXT Adapter): 0.04%

BioChambers

BioChambers provide a way for both CO_2 Gas and O_2 Gas sensors to be used at the same time in a closed system.

BioChamber 2000, 2000 mL
ORDER CODE **BC-2000**

BioChamber 250, 250 mL
ORDER CODE **BC-250**

GREAT WAYS TO USE THIS SENSOR!

BIOLOGY

- Enzyme action: testing catalase activity
- Cell respiration in peas
- Effect of temperature on cold-blooded organisms
- Oxygen gas and human respiration
- Photosynthesis and respiration
- Measure O_2 along with CO_2 in photosynthesis and respiration

HUMAN PHYSIOLOGY

- Oxygen and aerobic metabolism
- Oxygen and extraction by the lungs
- Effect of "dead space" on oxygen availability

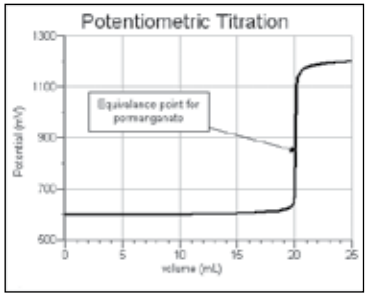
ORP Sensor

ORDER CODE
ORP-BTA

The Oxidation-Reduction Potential (ORP) Sensor lets you measure the ability of a solution to act as an oxidizing or reducing agent.

- Measure the oxidizing ability of chlorine in swimming pools or determine when the equivalence point has been reached in an oxidation-reduction reaction.
- Amplifier included.

RANGE: -450 to 1100 mV
RESOLUTION:
12-bit (LabQuest, LabQuest Mini, LabPro, Go! Link): 0.5 mV
10-bit (CBL, CBL 2, NXT Adapter): 2 mV



ORP mV vs. volume data for the titration of hydrogen peroxide solution with potassium permanganate

GREAT WAYS TO USE THIS SENSOR!

CHEMISTRY

- An oxidation-reduction titration: the reaction of Fe^{2+} and Ce^{4+}
- Potentiometric titration of hydrogen peroxide and permanganate
- Measure oxidizing potential of chlorine in swimming pools

pH Sensor

ORDER CODE
PH-BTA

Our general purpose pH Sensor is an Ag-AgCl combination electrode. It can be used across disciplines, including chemistry, biology, middle school science, and environmental science.

- Includes a convenient soaking bottle and storage solution.
- Individually calibrated, with a range from 0 to 14 pH units.
- pH Buffer Capsules (ORDER CODE PHB) and pH Storage Solution (ORDER CODE PH-SS) are available.

RANGE: 0 to 14 pH units
RESOLUTION:
12-bit (LabQuest, LabQuest Mini, LabPro, Go!Link, SensorDAQ): 0.005 pH units
10-bit (CBL, CBL 2, NXT Adapter): 0.02 pH units

Tris-Compatible Flat pH Sensor

ORDER CODE
FPH-BTA

This new specialty pH Sensor uses a double-junction electrode, making it compatible with Tris buffers and solutions containing proteins. The flat glass shape also makes it ideal for measuring the pH of semisolids such as food or soil.

GREAT WAYS TO USE THESE SENSORS!

pH SENSOR

CHEMISTRY
- Acid-base titration
- Titration of a diprotic acid: identifying an unknown
- Acid dissociation constant, K_a
- Investigating indicators
- Investigating buffers

PHYSICAL SCIENCE
- Household acids and bases
- Acid rain

BIOLOGY
- Interdependence of plants and animals
- Watershed testing

TRIS-COMPATIBLE FLAT pH SENSOR

AGRICULTURAL SCIENCE
- Soil pH

BIOLOGY
- Applications involving Tris buffers or proteinaceous solutions

EARTH SCIENCE
- Soil pH
- Soil and acid rate

Photogate and Accessories

Photogate

ORDER CODE
VPG-BTD

Use the Vernier Photogate to study free fall, rolling objects, collisions, and pendulums.

- Use the built-in laser detector to create a photogate through which you could drive a truck.
- Connect up to four gates in a chain.
- Includes an accessory rod for attachment to a ring stand or for adding the Ultra Pulley Attachment.

Photogate Accessories

Ultra Pulley Attachment
ORDER CODE **SPA**

Add an Ultra Pulley to your Photogate to monitor motion as a string passes over the pulley or as the pulley rolls along a table.

Picket Fence
ORDER CODE **PF**

Our Picket Fence has 8 opaque bars silk-screened at intervals of 5 cm directly onto clear plastic. These devices are especially good for dropping through a photogate to study free fall.

Cart Picket Fence
ORDER CODE **PF-CART**

Attaches to Vernier Dynamics Carts.

GREAT WAYS TO USE THIS SENSOR!

PHYSICS
- Determining the acceleration due to gravity
- Determining the speed of a rolling object
- Measure acceleration in an Atwood's machine
- Measure pendulum periods

Laser Pointer
ORDER CODE **LASER**

This Class IIIa (<5 mW) laser pointer can be used with the Vernier Photogate to produce a gate that is wider than the normal 7.5 cm spacing, making it possible to measure the speed of an automobile or of a person running. The laser case is made of aircraft aluminum, and uses two AAA batteries (included). The wavelength of the light is 650 nm.

Laser Pointer Stand
ORDER CODE **STAND**

This light-weight tripod is a perfect support for the laser described above, which has a 1.1 cm outside diameter. The stand features fold-out legs and a clip attached to the adjustable ball. A socket head assembly securely holds the laser in place. This assembly allows you to accurately point the laser at the photogate. A VELCRO® strap, integrated into one of the tripod legs, allows you to attach the laser to objects, such as ring stands and railings.

Pulley Bracket
ORDER CODE **B-SPA**

The Pulley Bracket attaches an Ultra Pulley to the end of a Vernier Dynamics Track.

Photogate Bar Tape Kit
ORDER CODE **TAPE-VPG**

The Photogate Bar Tape Kit contains a flexible plastic tape called "Bar Tape" and a guide that allows the tape to be used with a Vernier Photogate. The tape can be attached to objects and pulled through the photogate. This allows you to perform experiments much like what you would do with a "ticker timer."

Power Amplifier

ORDER CODE
PAMP

The Vernier Power Amplifier allows you to drive loads with ±10 V and currents up to 1 A. Works with any waveform. The Power Amplifier can drive a variety of loads, including speakers, lamps, motors, and circuits.

- Utilizes internal feedback for accurate AC waveforms and DC levels.
- Can provide a steady, linearly controlled DC output for driving loads like DC motors, and precise AC waveforms for driving things like speakers.
- Current limited to protect against overload and shorting.
- Current monitor function logs current.
- Class A-B Push-Pull Amplifier provides low distortion with good efficiency.
- Works with LabQuest, LabPro, and SensorDAQ

OUTPUT VOLTAGE SWING (AMPLITUDE): ±10 V
MAX. OUTPUT CURRENT: 1 A
FREQUENCY RESPONSE: DC-20 kHz (-3db @ 20 kHz, flat to ~15 kHz)
OUTPUT IMPEDANCE: <1 Ω

Power Amplifier Accessory Speaker

ORDER CODE **PAAS-PAMP**

This kit includes a speaker and accessories used with the Vernier Power Amplifier to study mechanical waves and springs. The speaker contains a light weight metal disc glued to the speaker cone.

GREAT WAYS TO USE THIS SENSOR!

PHYSICS

- Produce standing wave patterns by vibrating one end of a string
- Investigate longitudinal resonance by oscillating a spring with a mass attached
- Study how resistance changes with heat by supplying a low frequency waveform to a incandescent lamp
- Study RC and RLC circuits

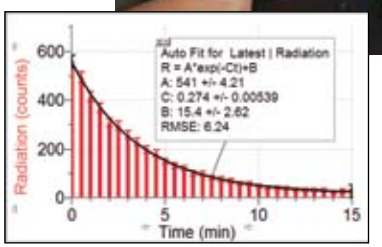
Radiation Monitor (Digital)

ALPHA, BETA, GAMMA

ORDER CODE
DRM-BTD

The Digital Radiation Monitor consists of a Geiger-Mueller tube and a digital rate meter mounted in a small, rugged, plastic case. The unit is battery operated and can be used with or without a computer for measurement of alpha, beta, and gamma radiation. It can be used to explore radiation statistics, measure the rate of nuclear decay, and monitor radon progeny.

Using the Digital Radiation Monitor to study low-level radiation from old Fiestaware®



Radioactive decay

GREAT WAYS TO USE THIS SENSOR!

PHYSICS

NUCLEAR RADIATION

- Distance and radiation
- Lifetime measurement
- Counting statistics
- Background radiation sources

CHEMISTRY

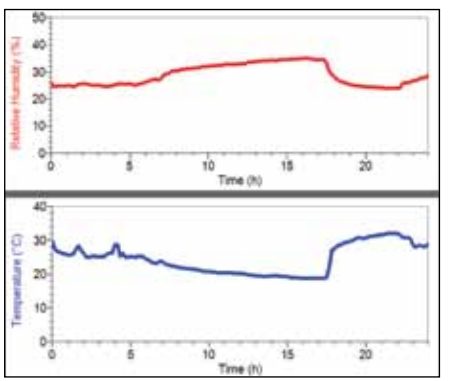
- Alpha, beta, and gamma
- Radiation shielding
- Determining the half-life of an isotope

Relative Humidity Sensor

ORDER CODE
RH-BTA

The Relative Humidity Sensor contains an integrated circuit that can be used to monitor relative humidity over the range of 0 to 95% (±5%). Use this sensor for weather studies, monitoring greenhouses, or for determining days when static electrical discharges could be a problem.

RANGE: 0 to 95%
TYPICAL ACCURACY: ±5%



Indoor relative humidity and temperature for a 24-hour period at Vernier

GREAT WAYS TO USE THIS SENSOR!

EARTH SCIENCE

- Air temperature and relative humidity

ENVIRONMENTAL SCIENCE

- A local weather study
- Ecocolumn investigations

INNOVATIVE USES

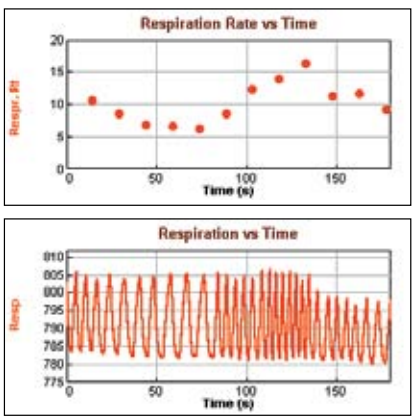
- Relative humidity in caves
- Monitoring indoor relative humidity for health

Respiration Monitor Belt

ORDER CODE
RMB

(Requires GPS-BTA)

The Respiration Monitor Belt is used with our Gas Pressure Sensor (see below) to measure human respiration. Simply strap the belt around your chest and pump air into the belt with the hand bulb. You can then monitor the pressure associated with the expansion and contraction of your chest during breathing.



Monitoring respiration rate

Gas Pressure Sensor

ORDER CODE **GPS-BTA**

This sensor is required for use with the Respiration Monitor Belt above. Details on page 108.

GREAT WAYS TO USE THIS SENSOR!

HUMAN PHYSIOLOGY
- Studying human respiration

BIOLOGY
- Control of human respiration

Rotary Motion Sensor

ORDER CODE
RMV-BTD

The Rotary Motion Sensor lets you monitor angular motion precisely and easily.

- Collect angular displacement, angular velocity, and angular acceleration data.
- Direction sensitive.
- Measure linear position to a fraction of a millimeter.

STANDARD RESOLUTION: 1.0°
(angular velocity up to 30 rev/s)

HIGH RESOLUTION: 0.25°
(angular velocity up to 7.5 rev/s)

Rotational Motion Accessory Kit

ORDER CODE **AK-RMV**

This accessory kit is used to study the motion of a physical pendulum; the rotational inertia of disks, rings, and point masses; and the conservation angular momentum. The kit includes:

- Two 8.9 cm diameter, 0.6 cm thick solid aluminum disks
- One steel disk with 2.9 cm central hole
- One plastic hub to hold the steel disk on the 3-step pulley
- One 38 cm hollow aluminum rod
- One Ultra Pulley
- One Ultra Pulley Swivel Mount, which allows the pulley to be mounted on the Rotary Motion Sensor

For more details, visit www.vernier.com/ak-**rmv**

Rotary Motion Motor Kit

ORDER CODE **MK-RMV**

This kit includes a small electric motor with pulley, rubber band belt, motor clip, and mounting screw. The motor can be attached to the Rotary Motion Sensor, and be used as an analog tachometer, or generator. You can also perform experiments that investigate motor efficiency in different conditions. For more details, visit www.vernier.com/mk-**rmv**

GREAT WAYS TO USE THIS SENSOR!

PHYSICS
- Atwood's machine experiments
- Measuring moments of inertia
- Torque experiments
- Physical pendulum
- Conservation of angular momentum

Salinity Sensor

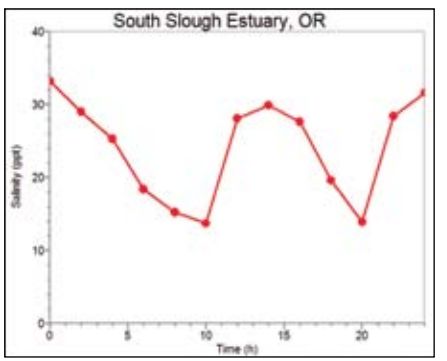
ORDER CODE
SAL-BTA

The Salinity Sensor easily and precisely measures the total dissolved salt content in ocean or brackish water.

- Measure water with a wide variety of salinities, from brackish water to ocean water, and even hyper-saline environments.
- Study how salinity affects buoyancy, or monitor salinity values in estuaries where fresh water mixes with salty ocean water.

RANGE: 0 to 50 ppt

RESOLUTION:
12-bit (LabQuest, LabQuest Mini, LabPro, Go!Link, SensorDAQ): 0.02 ppt
10-bit (CBL, CBL 2, NXT Adapter): 0.08 ppt



Measuring salinity in an estuary

GREAT WAYS TO USE THIS SENSOR!

ENVIRONMENTAL SCIENCE
- Studying salinity in an estuary
- Measure salinity in ocean or brackish water

INNOVATIVE USES
- GIS mapping enhances salinity
- Investigating salinity levels
- Ionic and molecular compounds
- Find the relationship between conductivity and concentration

Soil Moisture Sensor

ORDER CODE
SMS-BTA

The Soil Moisture Sensor uses capacitance to measure the water content of soil. Simply insert this rugged sensor into the soil to be tested, and the volumetric water content of soil is reported in percent. Use it to conduct experiments in ecology, environmental science, agricultural science, horticulture, biology, and more.

RANGE: 0 to 100%
RESOLUTION:
12-bit (LabQuest, LabQuest Mini, LabPro, Go!Link, SensorDAQ): 0.1%
10-bit (CBL, CBL 2, NXT Adapter): 0.4%

Monitoring changes in soil moisture in ecocolumns

GREAT WAYS TO USE THIS SENSOR!

EARTH SCIENCE
- Measure the loss of soil moisture over time due to evaporation and plant uptake
- Evaluate optimum soil moisture contents for various species of plants
- Monitor soil moisture content to control irrigation in greenhouses

ENVIRONMENTAL SCIENCE
- Manage garden soil moisture
- Ecocolumn investigations
- Pollution study

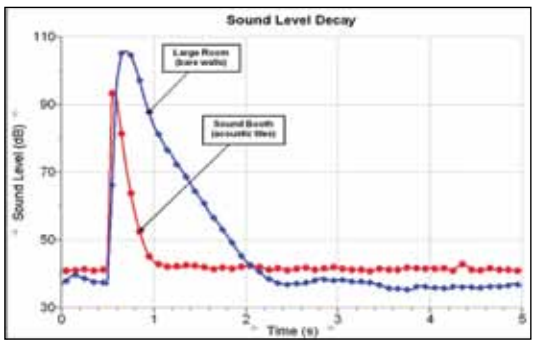
AGRICULTURAL SCIENCE
- Soil Moisture

Sound Level Meter

ORDER CODE
SLM-BTA

The Sound Level Meter is used to measure sound level in decibels (dB). An output port on the meter records sound level data. A switch on the meter is used to select dBA or dBC weighting. The Sound Level Meter also has an LCD panel, which allows you to use it as a standalone device. A dB range switch and a response switch provide flexibility in the standalone mode.

RANGE: 35 to 130 dB
ACCURACY: 1.5 dB at 94 dB
FREQUENCY RESPONSE: 31.5 to 8,000 Hz



Sound level decay in two rooms

GREAT WAYS TO USE THIS SENSOR!

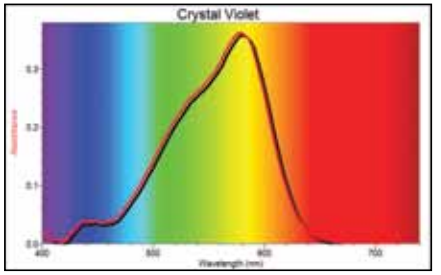
INNOVATIVE USES
- Study reverberation times
- Investigating airport noise
- Investigate room acoustics
- Measuring sound levels at a pep rally
- Investigate traffic noise
- Use for environmental noise studies

SpectroVis® Plus Spectrophotometer

ORDER CODE
SVIS-PL

The SpectroVis Plus has been improved with a wider range, higher resolution, and the addition of fluorescence. Details on pp. 42–43.

RANGE: 380-950 nm
Fluorescence excitation centered at 405 nm and 500 nm
RESOLUTION:
~2.5 nm optical resolution, 570 wavelengths, 1 nm reporting intervals



Absorbance spectrum of crystal violet

SpectroVis® Optical Fiber

ORDER CODE **SVIS-FIBER**

Turn your SpectroVis spectrophotometer into an emissions spectrometer using the SpectroVis Optical Fiber insert. For more details, see www.vernier.com/spectroscopy

For more on spectrometers, see pp. 41.

GREAT WAYS TO USE THIS SENSOR!

CHEMISTRY
- Beer's law
- Kinetics studies
- Determine chemical composition based on absorption spectra

PHYSICS
- Emission spectra of gases
- Emission spectra of lamps

BIOLOGY
- Visible spectrum of chlorophyll
- Photosynthesis

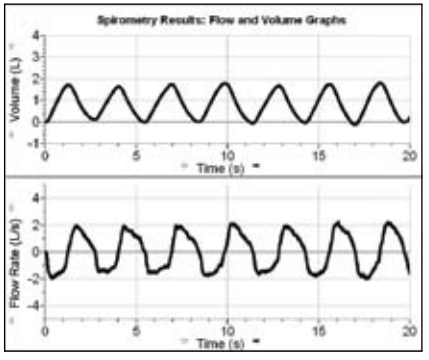
Spirometer

ORDER CODE
SPR-BTA

Use the Spirometer to perform a variety of tests related to air flow and lung volume.

- Designed to measure human respiration at rest and during moderate activity.
- Includes a removable flow head (22 mm ID/30 mm OD) for easy cleaning and sterilization, in addition to 5 disposable mouthpieces, 1 disposable bacterial filter, and 2 nose clips.

FLOW RANGE: ±600 L/min **DEAD SPACE:** 93 mL



Measuring lung volume

GREAT WAYS TO USE THIS SENSOR!

HUMAN PHYSIOLOGY
- Lung volumes and capacities
- Respiratory response to physiologic challenges
- Analysis of lung function
- Oxygen and aerobic metabolism

Spirometer Replacement Parts

Disposable Bacterial Filter
(pkg. of 10)
ORDER CODE **SPR-FIL**

Use of the disposable microbacterial filter significantly reduces how often you will need to sterilize your spirometer's flow head. The filter's 30 mm ID opening allows for an easy, air-tight fit to the flow head.

Disposable Mouthpiece
(pkg. of 30)
ORDER CODE **SPR-MP**

For a more sterile environment, use the cardboard mouthpieces to help eliminate the spreading of contagious material between students.

Noseclip *(pkg. of 10)*
ORDER CODE **SPR-NOSE**

These plastic, foam-padded noseclips help increase the precision of your spirometry results by eliminating the escape of air through the nostrils during testing.

Extra Spirometer Flow Head
ORDER CODE **SPR-FLOW**

An extra flow head eliminates equipment downtime while sterilizing your original flow head. The flow head consists of a polycarbonate outer body with a stainless-steel inner mesh.

Temperature Probes

Stainless Steel Temperature Probe

ORDER CODE
TMP-BTA

This rugged and durable temperature probe has a sealed stainless steel shaft and tip that can be used in organic liquids, salt solutions, acids, and bases.

RANGE: -40 to 135°C

12-bit Resolution (LabQuest, LabQuest Mini, LabPro, Go!Link, SensorDAQ):	10-bit Resolution (CBL, CBL 2, NXT Adapter):
0.17°C (-40 to 0°C)	0.68°C (-40 to 0°C)
0.03°C (0 to 40°C)	0.12°C (0 to 40°C)
0.1°C (40 to 100°C)	0.4°C (40 to 100°C)
0.25°C (100 to 135°C)	1.0°C (100 to 135°C)

Extra-Long Temperature Probe

ORDER CODE
TPL-BTA

This probe has a 30-meter (100 ft) cable. It is designed for remote, outdoor temperature sensing or for measuring temperature at various depths in lakes and streams.

RANGE: -50 to +150°C

12-bit Resolution (LabQuest, LabQuest Mini, LabPro, Go!Link): 0.07°C
10-bit Resolution (CBL, CBL 2): 0.3°C

For USB temperature probes, see pp. 15, 99.

GREAT WAYS TO USE THE STAINLESS STEEL TEMP PROBE!

CHEMISTRY
- Endothermic and exothermic reactions
- Freezing and melting of water
- Heat of fusion of ice
- Pressure-temperature relationship in gases
- Evaporation and intermolecular attractions

MIDDLE SCHOOL
- Heating of land and water
- The greenhouse effect
- Absorption of radiant energy

PHYSICS
- Newton's law of cooling

BIOLOGY
- Energy in food
- Biodiversity and ecosystems
- Aerobic respiration
- Dissolved oxygen *vs.* temperature

PHYSICAL SCIENCE
- Boiling temperature of water
- Freezing temperature of water
- Insulation

Temperature Probes (continued)

Surface Temperature Sensor

ORDER CODE
STS-BTA

Featuring an exposed thermistor that results in an extremely rapid response time, the Surface Temperature Sensor is ideal for situations in which low thermal mass or flexibility is required, or for a skin temperature measurement. This design allows for use in air and water.

RANGE: -25 to 125°C

12-bit Resolution (LabQuest, LabQuest Mini, LabPro, Go!Link, SensorDAQ):	10-bit Resolution (CBL, CBL 2, NXT Adapter):
0.08°C (-25 to 0°C)	0.3°C (-25 to 0°C)
0.03°C (0 to 40°C)	0.12°C (0 to 40°C)
0.1°C (40 to 100°C)	0.4°C (40 to 100°C)
0.25°C (100 to 125°C)	1.0°C (100 to 125°C)

Infrared Thermometer

ORDER CODE
IRT-BTA

The Infrared Thermometer is a non-contact, fast-responding temperature measuring device. The sensor works by measuring the infrared radiation emitted by objects. You simply point the sensor at the object and read its temperature.

RANGE: -20 to 400°C
ACCURACY: ±3% of reading or ±3°C, whichever is greater at 18 to 28°C ambient operating temperature
EMISSIVITY: preset 0.95

GREAT WAYS TO USE THESE SENSORS!

CHEMISTRY
- Endothermic and exothermic reactions
- Freezing and melting of water
- Heat of fusion of ice
- Pressure-temperature relationship in gases
- Evaporation and intermolecular attractions

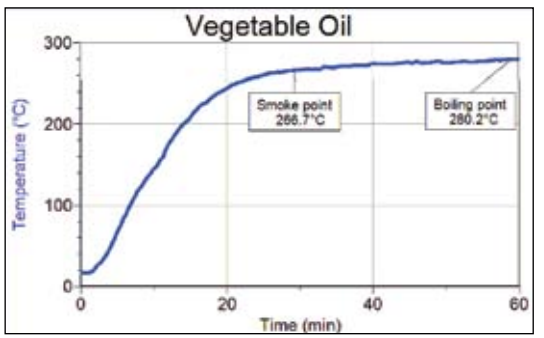
INFRARED THERMOMETER SENSOR:
INNOVATIVE USES
- Measure the temperature of hard-to-reach objects
- Investigate skin temperature
- Compare the temperature of your palm, forearm, or foot
- Compare the temperature of cars parked in the sun

Wide-Range Temperature Probe

ORDER CODE
WRT-BTA

This temperature probe features a temperature range of -20°C to 330°C, which allows for melting point determinations of most organic compounds.
- Sealed, stainless-steel shaft can be used in organic liquids, salt solutions, acids, and bases.
- Long enough to extend into flasks and other common glassware.
- Narrow diameter allows it to fit snugly in openings designed for thermometers.

RANGE SETTINGS: -20 to 330°C
ACCURACY: ±0.1°C throughout the temperature range
12-bit Resolution: 0.1°C



Temperature of vegetable oil using a Wide-Range Temperature Probe

GREAT WAYS TO USE THIS SENSOR!

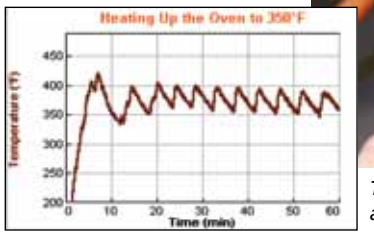
CHEMISTRY
- Fractional distillation
- Melting temperature of organic compounds
- Determining enthalpy of a chemical reaction
- Synthesis and analysis of aspirin

Thermocouple

ORDER CODE
TCA-BTA

The Thermocouple uses type-K thermocouple wire to measure temperatures between -200°C and 1400°C.
- Measure liquid nitrogen temperatures at -196°C and flame temperatures up to 1400°C.
- Internal ice-point compensation means you do not need to place a reference wire in an ice-water bath.
- Individually calibrated.

RANGE:	TYPICAL ACCURACY:
-200 to 1400°C	0 to 900°C: ±2°C -200 to 0°C: ±5°C 900 to 1400°C: ±15°C



Temperature cycles of an oven using a Thermocouple

Taking temperature of an open flame

GREAT WAYS TO USE THIS SENSOR!

INNOVATIVE USES
- Compare the temperature at different parts of a flame
- Compare the temperature of different flames
- Temperature cycles of an oven
- Monitor temperature of liquid nitrogen or dry ice
- Determine the melting point of copper or other solids

Turbidity Sensor

ORDER CODE
TRB-BTA

Use the Turbidity Sensor to measure the turbidity of freshwater or seawater samples in NTU (the standard unit used by most water collection agencies and organizations).

- Small, sleek design and simple setup make it easy to use at the collection site or in the classroom.
- Monitor precipitate formation or algae and yeast populations in chemistry and biology classes.
- Includes high-quality Hach StablCal™ 100 NTU standard for quick calibration and a high-grade glass cuvette for your water sample.

RANGE: 0 to 200 NTU

RESOLUTION:
12-bit (LabQuest, LabQuest Mini, LabPro, Go!Link): 0.25 NTU
10-bit (CBL, CBL 2, NXT Adapter): 1.0 NTU

Measuring turbidity of a stream sample

GREAT WAYS TO USE THIS SENSOR!

WATER QUALITY
- Monitor water clarity

ENVIRONMENTAL SCIENCE
- Long term water monitoring
- Pollution study

EARTH SCIENCE
- Water quality: turbidity
- Water treatment

UVA and UVB Sensors

ORDER CODE
UVA-BTA

ORDER CODE
UVB-BTA

We have two different sensors for measuring the intensity of ultraviolet radiation. One responds primarily to UVA radiation (320 – 375 nm), and another responds primarily to UVB radiation (290 – 320 nm). UVB radiation is commonly associated with sunburns, cataracts, and skin cancer. UVA radiation, while responsible for suntans, is also a cause of premature aging of the skin and some types of skin cancer. Which sensor you use will depend upon the particular experiment you want to perform.

UVA SENSOR
Great for use with UV lamps.

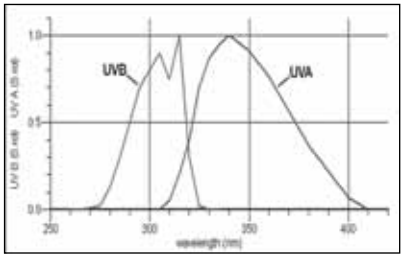
RANGE: 0 – 18,000 mW/m²
Wavelength sensitivity region approximately 320 – 375 nm
UV peak sensitivity: one volt per 3940 mW/m² at 340 nm

RESOLUTION:
12-bit (LabQuest, LabQuest Mini, LabPro, Go!Link, SensorDAQ): 5 mW/m²
10-bit (CBL, CBL 2, NXT Adapter): 20 mW/m

UVB SENSOR
Great for use in the sun. Recommended for our lab books.

RANGE: 0 – 900 mW/m²
Wavelength sensitivity region approximately 290 – 320 nm
UV peak sensitivity: one volt per 204 mW/m² at 315 nm

RESOLUTION:
12-bit (LabQuest, LabQuest Mini, LabPro, Go!Link, SensorDAQ): 0.3 mW/m²
10-bit (CBL, CBL 2, NXT Adapter): 1 mW/m



Spectral response of the UV Sensors

GREAT WAYS TO USE THESE SENSORS!

EARTH SCIENCE
- Compare absorption in glasses
- Comparing sunscreens
- UV light and clothing

ENVIRONMENTAL SCIENCE
- Collect local weather data
- UV investigations

Voltage Probes

Differential Voltage Probe

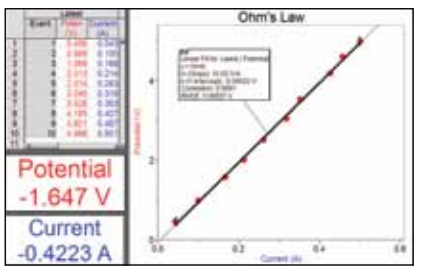
ORDER CODE
DVP-BTA

The Differential Voltage Probe is designed for exploring basic principles of electricity, including studying series and parallel circuits.

- Ideal for use in most battery and bulb circuits.
- Can be used to study low-voltage AC and DC circuits.
- Combine with a Current Probe to explore Ohm's law, phase relationships, and much more.

This sensor differs from our Voltage Probe (ORDER CODE VP-BTA) in that neither of the clips are grounded, making it possible to use two probes in the same circuit simultaneously.

RANGE: -6.0 to +6.0 V **INPUT IMPEDANCE:** 10 MΩ
RESOLUTION:
12-bit (LabQuest, LabQuest Mini, LabPro, Go!Link, SensorDAQ): 3.1 mV
10-bit (CBL, CBL 2, NXT Adapter): 12.5 mV



Logger Pro graph showing Ohm's law using the Current Probe, Differential Voltage Probe, and the Vernier Circuit Board

GREAT WAYS TO USE THIS SENSOR!

PHYSICS
- Ohm's law
- Series and parallel circuits
- Electrical energy
- Capacitors

PHYSICAL SCIENCE
- Battery and bulb investigations

Voltage Probes (continued)

Voltage Probe

ORDER CODE
VP-BTA

This Voltage Probe can be used to measure the potential in direct-current or alternating-current circuits. In chemistry, physical science, or middle school science classes, the Voltage Probe can be used to measure voltages developed in a variety of electrochemical (voltaic) cells.

RANGE: -10 to +10 V

RESOLUTION:
12-bit (LabQuest, LabQuest Mini, LabPro, SensorDAQ): 0.005 V (5 mV)
10-bit (CBL, CBL 2): 0.020 V (20 mV)

NEW 30-Volt Voltage Probe

ORDER CODE
30V-BTA

This sensor is used to measure voltages in the range of -30 to +30 volts. Use this sensor in experiments that involve voltages larger than 10 volts, such as when working with large solar panels. Since this voltage probe covers such a wide voltage range, its resolution is lower than our Differential Voltage Probe (page 119), which we recommend for most experiments.

RANGE: -30 to +30 V

GREAT WAYS TO USE THESE SENSORS!

VOLTAGE PROBE

CHEMISTRY
- Establishing a table of reduction potentials: micro-voltaic cell
- Lead storage batteries

PHYSICS
- Capacitor charging

MIDDLE SCHOOL
- Fruit and metal voltaic cells

30-VOLT VOLTAGE PROBE

INNOVATIVE USE
- Measure output from large solar panels

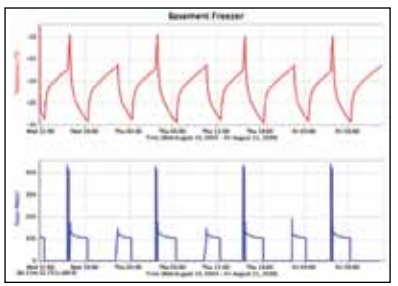
Watts Up Pro

ORDER CODE
WU-PRO

Watts Up Pro measures real-time energy use of common electrical devices. Find out which costs more: running a hairdryer for 10 minutes, or leaving on a lamp all afternoon? Measures potential, current, power, and cumulative cost.

- Connects to the USB port on your computer or LabQuest—no other devices needed.
- Use at the same time as a LabQuest, LabQuest Mini, LabPro, or Go!Link to monitor electricity usage in combination with other data, such as temperature, light, and relative humidity.
- The LCD panel on Watts Up Pro allows it to be used as a standalone device.

VOLTAGE: 120 V
MINIMUM MEASURABLE POWER: 0.5 watts
ACCURACY: ±1.5%, + 3 counts of the displayed value



Measuring temperature and power consumption in a basement freezer

GREAT WAYS TO USE THIS SENSOR!

INNOVATIVE USES
- Long-term monitoring of devices
- How can I save money?
- Investigate phantom load
- Compare energy use of different types of light bulbs
- Study energy use of different devices
- Analyze energy use of different wattage light bulbs

Wireless Dynamics Sensor System (WDSS)

ORDER CODE
WDSS

The WDSS combines a 3-axis accelerometer, force sensor, and altimeter into one unit that communicates wirelessly with your computer via Bluetooth®.

- Use it with your Bluetooth-enabled computer and Logger *Pro* to collect data free of friction due to cables.
- Internal data storage capacity allows you to use it as a standalone data logger. Great for roller coaster physics.

(Requires a Bluetooth-enabled computer and Logger Pro *software. See page 121 for Bluetooth Dongle.)*

WDSS accessories on next page.

INTERNAL DATA STORAGE CAPACITY: 240,000 points
MAXIMUM SAMPLING RATE: 1000 samples/s

FORCE	**RANGE:** ±50 N **RESOLUTION:** 0.006 N (<10 N) 0.03 N (>10 N)
ACCELEROMETERS *(for each axis)*	**RANGE:** ±50 m/s² (±5 g) **RESOLUTION:** 0.04 m/s²
ALTIMETER	**ALTITUDE CHANGE RANGE:** +/-200 m **RESOLUTION:** 1 m

Acceleration on a swing

GREAT WAYS TO USE THIS SENSOR!

PHYSICS
- Roller coaster accelerations
- Skateboarding
- Newton's second law
- Newton's third law
- Centripetal acceleration on a turntable or a merry-go-round
- Force and acceleration in simple harmonic motion

WDSS Accessories

WDSS Rechargeable Battery

ORDER CODE **WDSS-BAT**

The WDSS comes with a rechargeable battery. This battery is needed only if your rechargeable battery wears out or if you would like to have a spare on hand.

WDSS Accessory Kit, ORDER CODE WDSS-ACC

These accessories are all included with a WDSS. This kit includes the most common pieces that might be misplaced.

- 6-inch aluminum rod with 1/4-20 stud
- Mounting plate for PASCO carts
- 3/4" 1/4-20 black screw
- #6-32 black nylon thumb nut
- 5/8" #10-24 binder bolt
- 1" #10-24 hex head bolt
- 1/4-20 eye bolt
- 1/4-20 black nylon thumb nut
- 1/2" #10-32 flat head screw (2)
- #6-32 threaded rubber bumper
- #6-32 hook
- 1/2" #6-32 aluminum standoff

Bluetooth USB Dongle Radio

ORDER CODE **BLUE-USB**

Each computer used with a WDSS must have a Bluetooth radio. This convenient USB dongle adds Bluetooth capabilities to any Windows XP SP2, Vista, or Mac OS X 10.3 or newer computer that lacks Bluetooth.

ISE MODULES AND STANDARDS

Ion-Selective Electrodes require good chemical technique and careful calibration to obtain accurate results. They are not recommended for middle school or elementary students.

ISE Replacement Modules are available for Ammonium, Calcium, and Nitrate Ion-Selective Electrodes (see order codes in chart on right). Chloride does not need a replacement module.

Important: ***We recommend that you do not purchase ISE replacement modules too far in advance of their expected time of use; degradation occurs while replacement modules are stored on the shelf.***

SENSOR ACCESSORIES AND REPLACEMENT PARTS

PART NAME	ORDER CODE
Blood Pressure Sensor	
Small Blood Pressure Cuff	CUFF-SM
Large Blood Pressure Cuff	CUFF-LG
Charge Sensor	
Electrostatics Kit	ESK-CRG
High Voltage Electrostatics Kit	HVEK-CRG
CO_2 and/or O_2 Gas Sensor	
BioChamber 250 *(250 mL) (2 openings)*	BC-250
BioChamber 2000 *(2000 mL) (2 openings)*	BC-2000
Respiration Chamber *(250 mL) (1 opening)*	CO2-BTL
Colorimeter/Spectrometer	
Colorimeter/Spectrometer Cuvettes *(pkg 100)*	CUV
Cuvette Rack	CUV-RACK
UV-VIS Spectrometer Cuvettes *(pkg 100)*	CUV-UV
Conductivity Probe	
Conductivity Low Standard *(500 mL)*	CON-LST
Conductivity Medium Standard *(500 mL)*	CON-MST
Conductivity High Standard *(500 mL)*	CON-HST
Dissolved Oxygen Probe	
D.O. Calibration Solution *(60 mL)*	DO-CAL
D.O. Filling Solution *(130 mL)*	FS
D.O. Polishing Strips	PS
D.O. Probe Membrane Cap	MEM
EKG Sensor	
EKG Electrodes	ELEC
Gas Pressure Sensor	
Pressure Sensor Accessories Kit	PS-ACC
#1 1-Hole Rubber Stopper	PS-STOP1
#5 2-Hole Rubber Stopper	PS-STOP5
Luer Lock Connector	PS-LUER
Plastic 2-Way Valve	PS-2WAY
Plastic Tubing	PS-TUBING
Plastic Tubing Clamps *(pkg. of 100)*	PTC
Stopper Stem	PS-STEM
Syringe	PS-SYR
Ion-Selective Electrodes	
ISE Ammonium Replacement Module	NH4-MOD
ISE Calcium Replacement Module	CA-MOD
ISE Nitrate Replacement Module	NO3-MOD
ISE Ammonium Low Standard *(500 mL)*	NH4-LST
ISE Ammonium High Standard *(500 mL)*	NH4-HST
ISE Calcium Low Standard *(500 mL)*	CA-LST
ISE Calcium High Standard *(500 mL)*	CA-HST
ISE Chloride Low Standard *(500 mL)*	CL-LST
ISE Chloride High Standard *(500 mL)*	CL-HST
ISE Nitrate Low Standard *(500 mL)*	NO3-LST
ISE Nitrate High Standard *(500 mL)*	NO3-HST
Melt Station	
Melt Station Capillary Tubes (pkg of 100)	MLT-TUBE

PART NAME	ORDER CODE
Mini GC	
GC Septa (pkg 4)	GC-SEP
GC Syringe, 1 µL Hamilton	GC-SYR-MIC
Motion Detector	
Motion Detector Clamp	MD-CLAMP
pH Sensor	
Microstirrer	MSTIR
pH Buffer Capsules	PHB
pH Electrode *(for EA-BTA only, with BNC connector)*	7120B
pH Storage Bottles *(pkg. of 5)*	BTL
pH Storage Solution *(500 mL)*	PH-SS
Photogate	
Bar Tape	TAPE
Cart Picket Fence	PF-CART
Laser Pointer	LASER
Laser Pointer Stand	STAND
Photogate Bar Tape Kit	TAPE-VPG
Picket Fence	PF
Pulley Bracket	B-SPA
Ultra Pulley Attachment	SPA
Power Amplifier	
Accessory Speaker	PAAS-PAMP
Rotary Motion	
Rotary Motion Accessory Kit	AK-RMV
Rotary Motion Motor Kit	MK-RMV
Centripetal Force Apparatus	CFA
Salinity Sensor	
Salinity Standard *(35 ppt salinity, 500 mL)*	SAL-ST
Spirometer	
Disposable Bacterial Filter *(pkg of 10)*	SPR-FIL
Disposable Mouthpiece *(pkg of 30)*	SPR-MP
Noseclip *(pkg of 10)*	SPR-NOSE
Spirometer Flow Head	SPR-FLOW
Turbidity Sensor	
Turbidity Cuvette and Standard	TRB-ACC
Vernier Dynamics System	
Adjustable Two Foot Leveler	AL-VDS
Bumper and Launcher Kit	BLK
Dynamics Track Adapter	DTA-DFS
Fasteners for DFS and Accelerometers	ACC-VDS
Mass (500 g)	MASS
Motion Detector Bracket	MDB-VDS
Optics Expansion Kit	OEK
Color Mixer Kit	CM-OEK
Photogate Bracket	PGB-VDS
Track-to-Track Coupler	T2T-VDS
Wireless Dynamic Sensor System Accessories	
WDSS Rechargeable Battery	WDSS-BAT
Bluetooth USB Dongle Radio	BLUE-USB
WDSS Accessory Kit	WDSS-ACC

a

b

c

LABQUEST ACCESSORIES/CABLES/POWER SUPPLIES

PART NAME	ORDER CODE
LabQuest Charging Station	LQ-CRG
LabQuest Computer Cable	LQ-CB-USB
LabQuest Power Supply	LQ-PS
LabQuest Tether (Quantity 5)	LQ-TETH-5
LabQuest Lanyard	LQ-LAN
LabQuest Battery	LQ-BAT
NEW LabQuest Battery Boost	LQ-BOOST
LabQuest 2GB SD Card	LQ-SD2
LabQuest Stand	LQ-STN
LabQuest Stylus (Quantity 5)	LQ-STYL-5
LabQuest International Power Supply	LQ-PS-INTL
LabQuest WiFi USB Adapter	WIFI-USB

LabQuest Accessories

a. LabQuest Charging Station

ORDER CODE **LQ-CRG**

With four charging slots, the LabQuest Charging Station lets you charge and store your interfaces more efficiently.

b. LabQuest Stand, ORDER CODE LQ-STN

This stand allows you to set the LabQuest at different angles and reduces the possibility of damage due to spills.

c. LabQuest Lanyard, ORDER CODE LQ-LAN

The lanyard connects to the back of the LabQuest to secure it around your students' neck while they are in the field. It can also be attached to a calculator cradle and used with a LabPro or CBL 2.

WiFi USB Adapter, ORDER CODE WIFI-USB

Add wireless connectivity to your LabQuest with the Vernier WiFi USB Adapter. For details see www.vernier.com/labqwifi.

NEW LabQuest Battery Boost

ORDER CODE **LQ-BOOST**

The Battery Boost is a rechargeable external battery for your LabQuest. With the added power of an external battery, data can be collected for extended periods where AC power is not available.

Do You Have Older Sensors?

ADAPTERS FOR OLDER VERNIER SENSORS

SENSOR	ADAPTER/CABLE
Analog "-DIN" Sensor	DIN-BTA
Motion Detector *(with removable cable)*	MDC-BTD *(cable)*
ULI Motion Detector *(older, non-removable cable)*	CBL-RJ11
Radiation Monitor *(older model)*	RAD-BTD *(cable)*
Rotary Motion Sensor *(older model)*	ROT-BTD
Vernier Photogate *(with removable cable)*	PG-BTD *(cable)*

DIN-to-BTA Adapter

DIN-to-BTA Adapter, ORDER CODE **DIN-BTA**

BTA-to-DIN Adapter, ORDER CODE **BTA-DIN**

Our older analog sensors have a round "DIN" 5-pin plug. Our new sensors have a "BT" (British Telecom) connector. Do you have an older-style DIN sensor with a round 5-pin plug that you want to plug into a LabQuest, LabQuest Mini, LabPro, Go!Link, or CBL 2? You need a DIN-to-BTA adapter (pictured here). The sensor will not auto ID, but it will work just fine.

CABLES / ADAPTERS / POWER SUPPLIES

PART NAME	ORDER CODE
AC Adapter *(for LabQuest or LabQuest Mini)*	LQ-PS
AC Adapter *(for LabPro, CBL 2, or CBL)*	IPS
Analog Sensor Extension Cable *(2 m)*	EXT-BTA
Digital Sensor Extension Cable *(2 m)*	EXT-BTD
Analog Protoboard Connector	BTA-ELV
Digital Protoboard Connector	BTD-ELV
Calculator-to-Calculator Link Cable	TI-CLC
Short Calculator Link Cable	TI-SLC
Go!Motion to Computer Cable	GMC-USB
LabPro→USB Cable *(Mac or PC)*	CB-USB
LabPro/CBL 2 Analog Cable	CB-BTA
LabPro/CBL 2 Digital Cable	CB-BTD
Mini-to-Standard USB Adapter	MINI-USB
Motion Detector Cable *(LabQuest, LabPro or CBL)*	MDC-BTD
Standard-to-Mini USB Adapter	USB-MINI

MORE ONLINE

Can't find the adapter you need? Check our complete list of adapters (including pictures) at www.vernier.com/adapters

Dave Vernier leads a workshop for a group of physics teachers

PROFESSIONAL DEVELOPMENT

About Our Trainers

Vernier's Professional Training Staff includes:

- 34 current or former classroom science and math teachers, all of whom have used Vernier equipment and software in their own classes.
- Teachers who, as a group, possess a total of 918 years of teaching experience, encompassing all subject areas and grade levels.
- Educators with prestigious teaching awards in their respective states and teaching subject areas, including seven Presidential Awardees, two Woodrow Wilson Dreyfus Master Teachers, three Tandy Technology Scholars, one Radio Shack Technology Awardee, one GTE Gift Awardee, one Excellence in Pre-College Physics Teaching Awardee, a variety of science educator of the year recipients in Arizona, Delaware, Kentucky, Maryland, New York, Oregon, South Dakota, Virginia, Washington and Wisconsin, and many other awards.
- Authors of more than 60 science books and lab manuals (including many of our own Vernier lab books).

Improving Teacher Effectiveness

Data-collection training gives teachers the skills to teach with the latest in sensor technology. All teachers will conclude their Vernier training with a certificate of completion indicating the number of hours spent in training. For more information on probeware and student achievement, see page 128.

Graduate Education Credit Available

Need to Earn Credit?

Attend one of our workshops that is four hours or longer, and you will have the opportunity to earn two (quarter) Graduate Science credit hours through the Portland State University Center for Science Education. For more information on this professional development option, see **www.vernier.com/gradcred**

Many states will offer Continuing Education Credit or clock hours for attendance at workshops held at professional conventions or at in-service training. We are happy to provide documentation of your attendance at any of our hands-on or demonstration workshops, hundreds of which are offered throughout the country each year. For more details, contact us at **pd@vernier.com**

FREE Hands-On, Data-Collection Workshops

LabQuest | Computer Data Collection

Join us for one of our free, 4-hour, hands-on workshops to learn how to integrate our computer and handheld data-collection technology into your chemistry, biology, physics, middle school science, physical science, and Earth science curriculum. The workshops include lunch or dinner and lab handouts on CD. Contact us or visit our web site for up-to-date information and registration.

This is a great opportunity for teachers who

- Want to evaluate our award-winning, data-collection technology.
- Are new to data collection.
- Need a refresher course on their Vernier equipment.
- Want to learn from the experts.

4 HOUR

HANDS-ON DATA-COLLECTION WORKSHOPS

SPRING WORKSHOPS

ARIZONA
Phoenix

ARKANSAS
Little Rock

CALIFORNIA
Pasadena
Riverside

COLORADO
Colorado Springs
Denver

CONNECTICUT
Hartford
Stamford

DELAWARE
Wilmington

FLORIDA
Fort Lauderdale
Orlando
Tampa

GEORGIA
Atlanta
Augusta

MARYLAND
Baltimore

NEW JERSEY
Newark

NEW MEXICO
Albuquerque

NORTH CAROLINA
Charlotte
Greensboro
Raleigh

PENNSYLVANIA
Allentown
Philadelphia

SOUTH CAROLINA
Columbia

TENNESSEE
Knoxville
Memphis
Nashville

TEXAS
Dallas
Houston
San Antonio

VIRGINIA
Fairfax County

WASHINGTON DC

WYOMING
Cheyenne

FALL WORKSHOPS

ILLINOIS
Chicago

IOWA
Des Moines

KANSAS
Topeka
Wichita

KENTUCKY
Lexington
Louisville

MASSACHUSETTS
Boston

MICHIGAN
Detroit

MINNESOTA
Minneapolis

MISSOURI
Kansas City

NEBRASKA
Omaha

NEW HAMPSHIRE
Nashua
Portsmouth

NEW YORK
Albany
Buffalo
Rochester

OHIO
Cincinnati
Cleveland
Columbus

OKLAHOMA
Oklahoma City
Tulsa

PENNSYLVANIA
Erie
Pittsburgh

RHODE ISLAND
Providence

TEXAS
Austin
Dallas
Houston
San Antonio

WEST VIRGINIA
Charleston

WISCONSIN
Madison
Milwaukee

One-Day Summer Workshops

LabQuest | Computer Data Collection

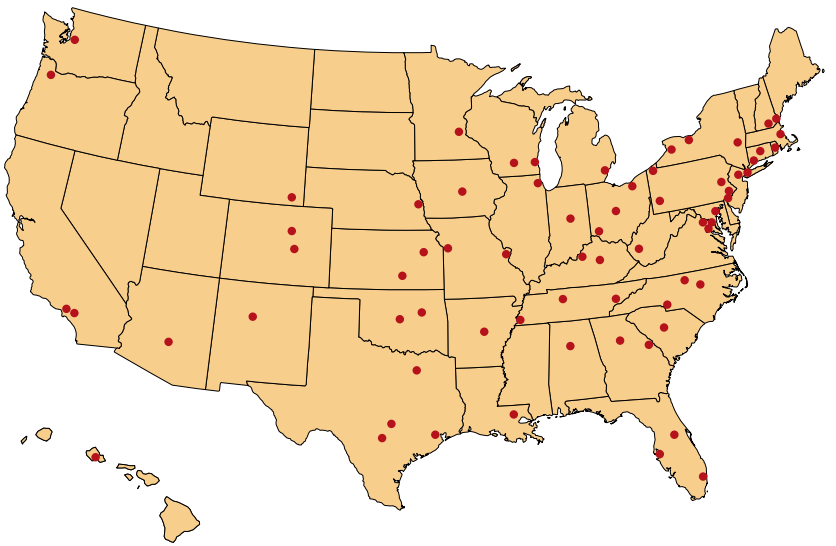
Join us for a day to learn how to integrate our data-collection technology into your chemistry, biology, physics, middle school science, physical science, and Earth science curriculum. These 6-hour, hands-on workshops include lunch and lab handouts on CD.

Registration form: www.vernier.com/workshop/summer.html

JUNE	JULY	AUGUST
Birmingham, AL Memphis, TN St. Louis, MO Dallas, TX Houston, TX	Baton Rouge, LA Chicago, IL Indianapolis, IN Columbus, OH	Providence, RI New York, NY Baltimore, MD Beaverton, OR Seattle, WA

1 DAY

Vernier 2011 Workshop Locations



MORE ONLINE
Information available at
www.vernier.com/workshop

Two-Day Subject-Specific Institutes

HIGH SCHOOL

JUNE	JULY
Raleigh, NC	Boston, MA

2 DAY

Physics /AP* Physics

These 2-day, hands-on institutes give novice and experienced users an opportunity to explore the use of technology in the teaching of physics. The activities will be built around the use of Vernier sensors and software. Three major areas of exploration will be provided: One will focus on the features of Logger *Pro* software that are especially useful to physics teachers; e.g., the analysis of movies and the addition of vectors to graphs and movies. The second area will explore a variety of data-collection options; i.e., computers, LabQuest, wireless, and remote. The third area will give participants an opportunity to use each Vernier physics sensor in at least one traditional experiment, inquiry activity, or lab practical. The registration fee includes a free copy of *Advanced Physics with Vernier – Mechanics.*

Biology/AP* Biology

These 2-day Biology/AP Biology Summer Institutes will feature hands-on training integrating technology into your biology and AP Biology classes. A variety of experiments will be offered, including many of the AP Biology lab activities recommended by The College Board. You will use LabQuest or a computer to collect and analyze data from classics like cell respiration, diffusion, and more. You will also be able to perform DNA gel electrophoresis and analyze the results using Logger *Pro* software. The registration fee includes a free copy of *Advanced Biology with Vernier*.

AP* Chemistry

Vernier and Flinn Scientific will co-host these AP Chemistry hands-on technology institutes. During these two-day summer workshops, teachers will do many of the 22 experiments recommended by The College Board. These experiments will center around Vernier and Flinn equipment, supplies, and kits, and are from the Vernier-Flinn lab book, *Advanced Chemistry with Vernier*. The registration fee includes a free copy of *Advanced Chemistry with Vernier*.

* AP and Advanced Placement Program are registered trademarks of the College Entrance Examination Board, which was not involved in the production of and does not endorse this product.

COLLEGE

AUGUST
Beaverton, OR Vernier Headquarters

2 DAY

College Physics

The 2-day College Physics Institute will survey all data-collection and video tools offered by Vernier. Participants will learn both basic and advanced skills in Logger *Pro*, including configuring graphs, performing custom curve fits, setting up calculated columns and customized data-collection modes. Video capture and analysis will be emphasized. Data collection will use LabQuest, LabQuest Mini, and wireless force sensors. All common physics sensors will be available, including rotary motion kits and optics devices. The registration fee includes a copy of *Advanced Physics with Vernier–Mechanics.*

College Biology

In this 2-day, hands-on institute, participants will conduct a series of laboratory exercises that are designed for general biology at the college level. Areas of focus will include cellular respiration, enzyme kinetics, photosynthesis, and transpiration. Biotechnology topics will be presented by our partners, Bio-Rad Laboratories. In addition, new experiments will be offered that explore fluorescence spectroscopy and basic protein biochemistry using our SpectroVis Plus Spectrometer/Fluorometer. Both basic and advanced training in Logger *Pro* and the use of LabQuest will be provided. Specific emphasis will be placed on how to conduct guided-inquiry based laboratory exercises at the college level. The registration fee includes a copy of *Advanced Biology with Vernier.*

College Chemistry

Vernier and Flinn Scientific team up to present this College Chemistry Institute. As a participant, you will have the opportunity to conduct up to twelve different experiments in the two-day session. You will investigate many important topics in chemistry, including thermodynamics, kinetics, acid-base reactivity, and equilibrium. Your practice with data collection and analysis via computer and LabQuest will lead to an increased understanding of the sensors and software, as well as open your eyes to new and interesting ideas for hands-on activities in your laboratory. In addition, special experiments will be offered that explore spectroscopy and gas chromatography. The registration fee includes a copy of *Advanced Chemistry with Vernier.*

FREE Hands-On Training at Conferences

Vernier will offer hands-on workshops at each of these conferences. For a full listing of our conference exhibits, check our web site at **www.vernier.com/workshop**

- **Hoosier Association of Science Teachers**
  Indianapolis, IN, February 9-11
- **NSTA National Convention**
  San Francisco, CA, March 10-13
- **ChemEd**
  Kalamazoo, MI, July 24-28
- **American Association of Physics Teachers**
  Omaha, NE, July 30-August 3
- **New Jersey Science Convention**
  Somerset, NJ, October 11-12
- **National Association of Biology Teachers**
  Anaheim, CA, October 12-15
- **California Science Teachers Association**
  Pasadena, CA, October 20-23
- **NSTA Area Convention**
  Hartford, CT, October 27-29
- **Conference for the Advancement of Science Teaching**
  Dallas, TX, November 3-5
- **Science Teachers Association of New York State**
  Rochester, NY, November 5-8
- **NSTA Area Convention**
  New Orleans, LA, November 10-12
- **Virginia Association of Science Teachers**
  Roanoke, VA, November 17-19
- **NSTA Area Convention**
  Seattle, WA, December 8-10

Vernier Workshop in Portland

We can conduct a one-day workshop at our office specially designed for you. The workshop can be training only (no charge) or it can include equipment as part of the cost. More information can be found at **www.vernier.com/workshop**

Vernier Workshop at Your School

We can come to your school to do a one-day, hands-on workshop using your Vernier equipment. This workshop can be computer or handheld-based data collection, in any science subject. More information and an on-site workshop application can be found on our web site at **www.vernier.com/workshop**

Webinars

Join us for a free, one-hour training on-line. Sessions are broadcast live on the web and recorded versions are available for download. Topics include: LabQuest 101, Physics: Video Analysis, and Chemistry: Beer's Law. For the schedule of upcoming webinars, go to **www.vernier.com/webinars**

LivePhoto Physics Workshops

This five day workshop is for college and university faculty and instructional staff. It will be held in Rochester, NY in June. For more information, go to **http://livephoto.rit.edu/workshops/**

Additional Workshops

For information on independent workshops that provide great instruction in the use of Vernier products, go to **www.vernier.com/workshop/independent.html**

Chautauqua Short Course:
Promoting Active Learning in Introductory Physics Courses with Research-Based Curricula and Tools

This hands-on course is designed for those who teach introductory physics at universities, colleges, and high schools. Graduate credit will be available from University of Oregon.

June 11-13, 2011
Vernier Software & Technology, Beaverton, OR

Instructors: Priscilla Laws (Dickinson College), David Sokoloff (University of Oregon), Ronald Thornton (Tufts University)

For more information and to register:
http://uoregon.edu/~sokoloff/chaut1.htm,
or contact David Sokoloff, sokoloff@uoregon.edu,
(541) 346-4755

GENERAL INFO

Why Choose Vernier?
Products and service that set us apart

Developed by Teachers, for Teachers
We understand the concerns of teachers, and we work hard to make your job easier. Our product development and technical support staff have over 100 years of teaching experience. We understand your concerns because we've been there.

Versatility that Translates into Savings
Vernier gives you more freedom of choice than any other probeware company. We offer state-of-the-art technology with the Vernier LabQuest. We offer a wide array of low-cost solutions with our Go! products and our new LabQuest Mini. And we offer the Vernier LabPro, which can be used with computers or TI graphing calculators.

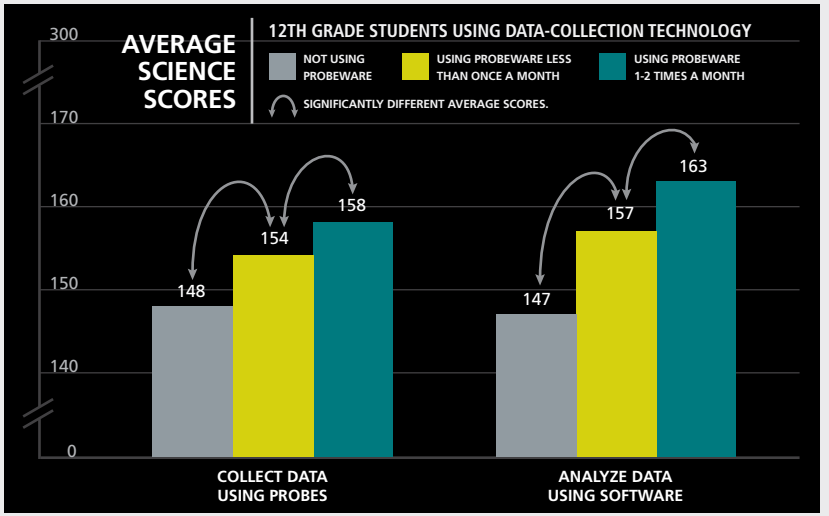
Generous Warranty that Lets You Buy with Confidence
Vernier's 5-year warranty gives you a superior level of buying confidence. In fact, in Vernier's 30 years of business, we have rarely charged a customer for a repair, no matter how old the equipment!

Logger *Pro* 3 Site License Offers Tremendous Value
Purchase our award-winning Logger *Pro* 3 software, and you are entitled to install the program on every computer in your school or college department AND give it to your students to use on their home computers. Excited? There's more.

Logger *Pro* 3 contains all the functions of Graphical Analysis software, including calculator-import and manual-entry data analysis features. That translates into the lowest total cost of software ownership in the education market, with access for every educator and student in your school. No other company offers such a generous site license policy. That's value!

Extraordinary Customer Service and Technical Support

When you call Vernier, you'll talk to a former teacher, a lab book author, or a technical expert. You'll speak with people who are passionate about education, science, and helping students succeed. What's the best part? You won't ever talk to sales representatives—just educators and people committed to extraordinary customer service for teachers.



Source: The 2000 NAEP Science Assessment. This study of 49,000 U.S. students shows that students who used probeware to collect and analyze data scored significantly higher on tests than those who did not.

Go to **www.vernier.com/research** for more details

New to Data Collection?

Why Should I Use Data-Collection Technology?

Data collection and analysis helps teachers increase students' critical thinking skills through hands-on learning. Students achieve higher test scores when probeware is included in engaging curricular activities.

Data-collection technology:

- Improves student understanding of science concepts.
- Frees class time for student engagement in higher-order thinking skills, such as analysis, synthesis, and evaluation.
- Supports STEM education and priorities outlined under ARRA and Race to the Top.
- Enables students to perform many new experiments with measurements not previously obtainable in the classroom.
- Increases test scores in science.
- Is recommended by national organizations, including NSTA, ISTE, ASTE, and IB.
- Encourages inquiry-based lab activities.
- Supports National Science Education Standards.

Request a White Paper on Probeware in Science

Hands-on science using Vernier technology gets students excited about science and deepens their understanding of complex concepts. It gives students the tools to analyze data and think like real scientists. For more on Probeware in Science, request our White Paper by e-mailing us at whitepaper@vernier.com

"Technology is needed…not just to give students exposure to the technology or to satisfy parents; technology greatly improves learning and supports science education standards that are difficult to teach without using technology."

Metcalf, S. J., & Tinker, R. 2003

TEEMSS: Technology Enhanced Elementary and Middle School Science, Annual Meeting of the National Association for Research in Science Teaching, March 23-26, 2003, Philadelphia

Vernier Grant Writing Guide

Looking to fund a state-of-the art science lab? Vernier has gathered a variety of resources to keep you informed with up-to-date details on available grants, and tips for writing a winning grant proposal.

Articles in the Vernier Grant Writing Guide include:

- Working with Your Idea
- Finding a Funding Source
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- Following Up on Your Grant

This guide will help you write a successful grant proposal and provide you with information on available funding sources.

MORE ONLINE
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Vernier / NSTA Technology Award

Win One of Seven Awards

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Go to **www.vernier.com/grants/nsta.html** for guidelines, a grant application, and profiles of previous winners.

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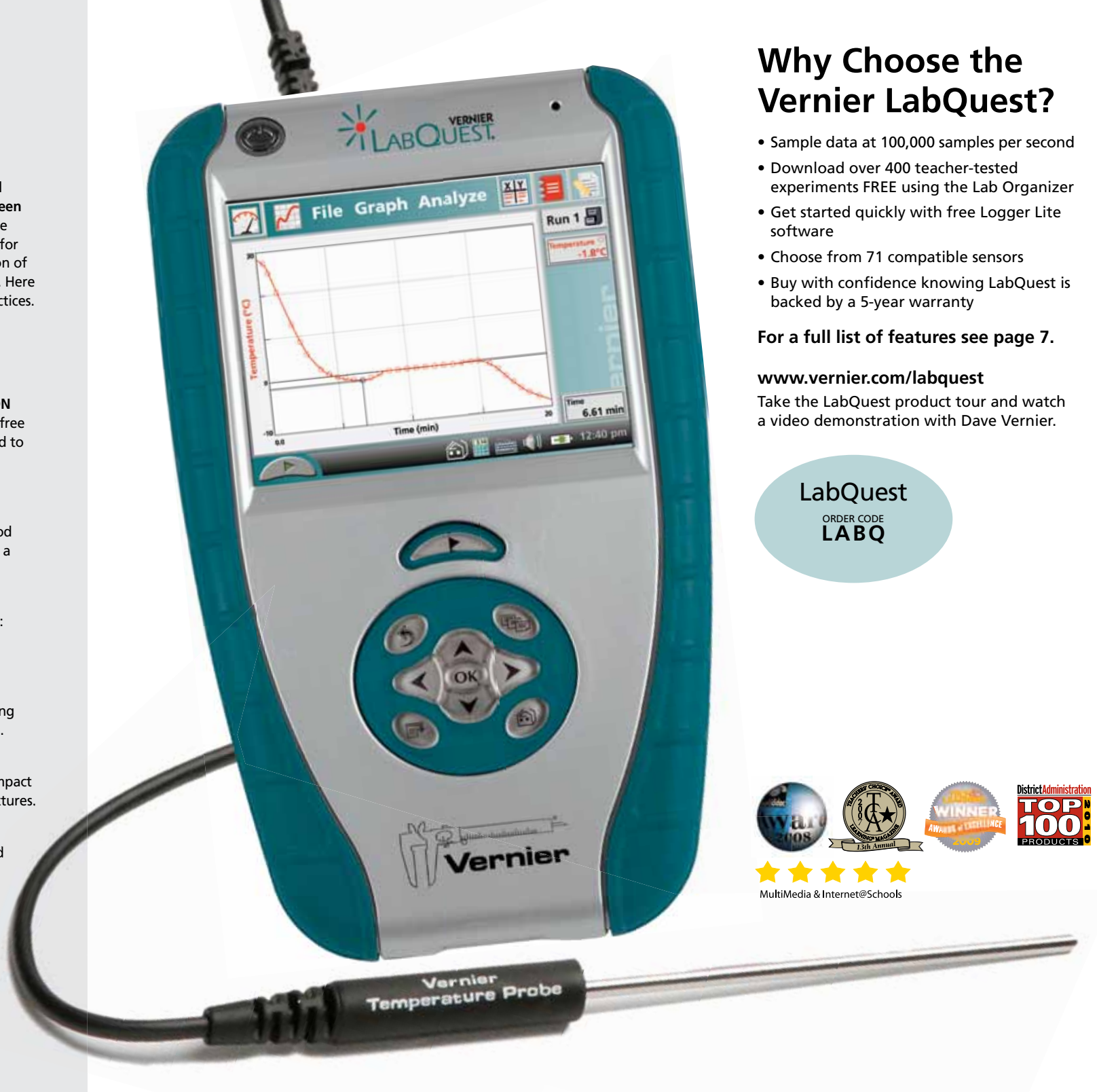

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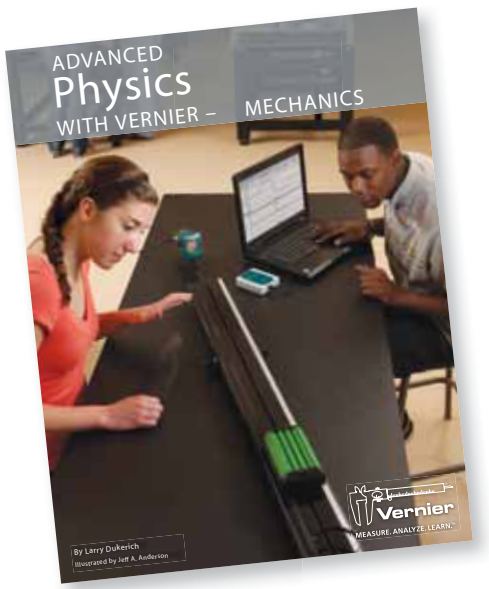

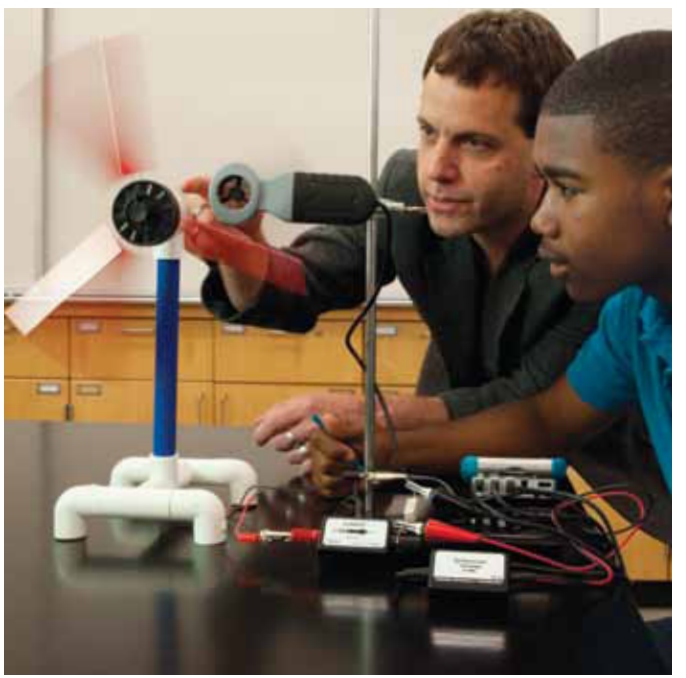

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